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The Scene at Grand Coulee—Design of Outlets for 225,000 Cu Ft per Sec Posed Unprecedented Problems (See page 779)

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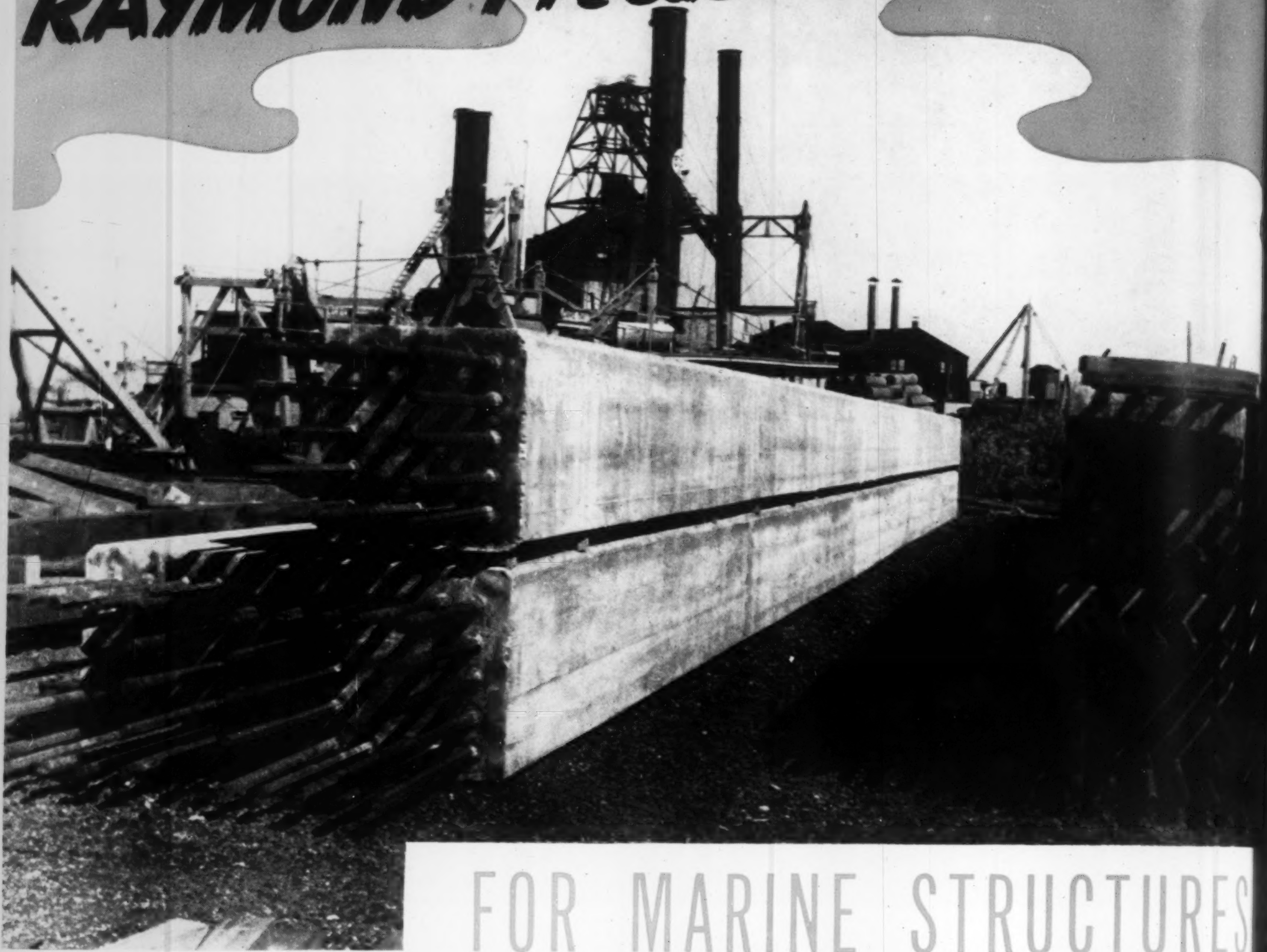
RAYMOND Precast Concrete Pile



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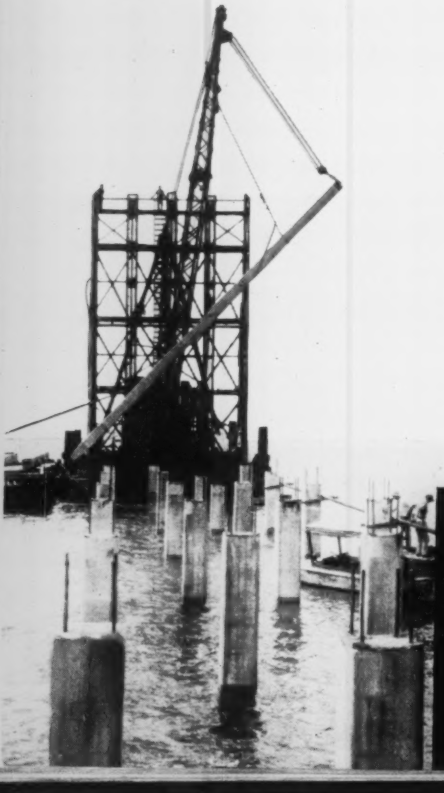

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Among Our Writers

Herbert J. Gilkey (Ore. State; Mass. Inst. of Tech.; U. of Ill., etc.) taught at the U. of Illinois from 1921 to 1923, and at the U. of Colorado from 1923 to 1931. Since the latter year he has headed the Department of Theoretical and Applied Mechanics at Iowa State College. During the war he served with the 29th Engineers in France.

Adolph J. Ackerman (U. of Wis., E.E. 1926, C.E. 1932) has been in dam and hydroelectric development work that has included earth dams for Fargo Engineering Co. in Michigan, Conowingo and Bartletts Ferry dams by Stone & Webster, and the Calderwood and Chute-à-Caron project for Aluminum Co. of America. He was contractor's chief engineer on the Madden Dam, Panama Canal Zone, and head construction plant engineer on TVA projects from 1933 to 1937.

LeRoy M. Hersum (M.I.T. 1922) opened his Boston office as a structural designer in 1929. He did the structural design on the Cage and Field House for Eric T. Huddleston of the U. of New Hampshire; and on the Gloucester (Mass.) High School. In 1936 and 1938 he designed many small bridges for the Commonwealth of Mass. He has also done consulting work in Atlanta, Ga.

Maurice Housecroft joined the Utah State Road Commission's Bridge Dept. in July 1920. His early education was gained in England. During his service with the British overseas forces in the last World War he was connected with many engineering works. He is chairman of the Bridge and Structures Committee of the Western Assn. of State Highway Officials.

Gavin Hadden, for the past 20 years in private practice in New York City, has specialized in recreational facilities and landing fields. He has served on the design of such notable structures as the stadiums at Cornell, Brown, Pennsylvania, Denver, and Northwestern U. In September 1940, he closed his office to enter the Construction Division of the Quartermaster Corps.

W. C. Sadler (U. of Ill., B.S. 1913, C.E. 1928; M.I.T., M.S. 1921; U. of Mich., L.L.B. 1930) joined the staff of the U. of Mich. nearly 15 years ago. His unusually varied engineering record includes construction of bridges, tunnels, docks, buildings, and hydroelectric structures. He was a captain with the 18th Railway Engineers for 2 years in France and has published considerable legal material, including a textbook, *Legal Aspects of Engineering*.

Jacob E. Warnock (Purdue 1925; C.E. 1934; U. of Col., M.S. 1939) progressed through the grades of junior, assistant, and associate engineer on hydraulic investigations for U.S. Engineer Offices in Tenn. and W.Va. From 1929 to 1931 he did similar work for the Aluminum Co. of America. Since that time he has been with the U.S. Bureau of Reclamation in charge of hydraulic laboratory work associated with such dams as the Grand Coulee, Boulder, Shasta, and Friant.

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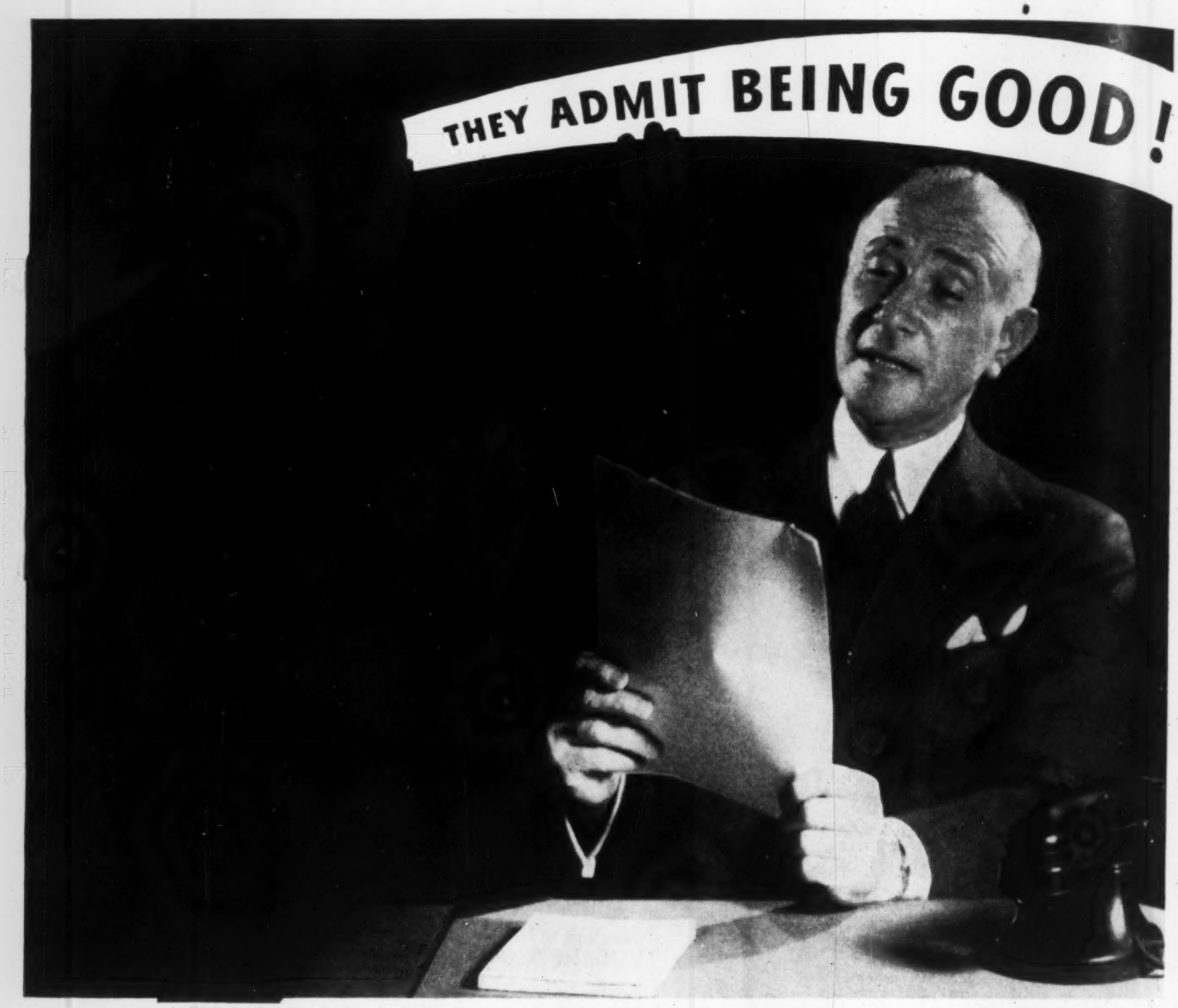
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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Extending Your Career

By Herbert J. Gilkey

Member American Society of Civil Engineers
Professor and Head, Department of Theoretical and Applied Mechanics,
Iowa State College, Ames, Iowa

In a previous editorial entitled "Launching a Career," in the June issue, Professor Gilkey mentioned a number of items which primarily concern the engineer immediately upon his graduation. This is an extension of that theme to include topics which assume greater and greater importance at a later stage in his career, as his responsibility increases.

As soon as you have risen above the bottom rung of the professional ladder, you will be required increasingly to select men for specific jobs. From your earliest cradle days you have been studying people, mainly, of course, subconsciously from the standpoint of congeniality or the attainment of personal ends.

Learn to Judge Men.~Professional selections are or should be largely a matter of cool appraisal rather than of personal fancy and intuition. Your subordinates are your masters; they, far more than your superiors, hold the keys to your destiny. You can do individually but a fraction of that for which you are personally held responsible. Beyond the stage of purely individual service, your progress will depend mainly upon your ability to select your subordinates wisely and implant in them the ideals that insure as good a performance as you yourself have visualized—or a better one.

One great engineering educator, with an almost uncanny ability to choose and develop men, once said that in selecting a man for a position, no matter how subordinate, he wanted to:

1. Interview the man personally.
2. Eat with him.
3. See him mixing with his fellows.

These specifications were superimposed, of course, upon the desired background of education, experience, and other technical or professional qualifications.

Being a Good Loser.~Doubtless you will lose a majority of your best selections; your competitors will attend to that. But when you make a poor choice, that man will be the huskiest pallbearer at your funeral.

Make it a cardinal principle never to hold a man against his own desire or better interest. If you cannot outbid your competitor, let your man go with your blessing and God-speed. In this way, others in your organization are supplied with tangible evidence of your interest in their welfare, even when it hurts. This begets loyalty. If you release a man grudgingly, you lose both an assistant and a friend. If you refuse to release him, you retain only the semblance of the man you had.

You will find that no one is so irreplaceable that you cannot better afford to lose him than to override his considered preference.

Fibbing vs. Tact.~No man likes to say unpleasant things, especially if these involve emotions and explanations that are hard for him to justify in his own mind or in the mind of his hearer. The result may be anything from a white lie to a black one. Perhaps truth, when bent, does not always form the arc of a circle; but it seems generally to do so—and sooner or later the circle closes. As we look back upon some of those rather delicate situations, which of our superiors do we remember with the greater respect and kindliness—(*a*) the man who with the utmost suavity smoothed our ruffled feathers with facts slightly colored and sent us happily on our way (to be disillusioned by some chance future happening); or (*b*) the man who with less suavity, perhaps, said only things, the truth of which no accident of the future could challenge? The words of the latter, whether savage or suave, left his mouth in straight lines, and straight lines do not double back on themselves.

Fortunate indeed is that man who is both truthful and tactful. Truth devoid of tact may produce some bad repercussions, but at least the worst is soon over instead of being charged with the potentialities of an unexploded bomb.

Who Gets the Credit?~I once saw the statement, "A man can get anything he wants done if he doesn't care who gets the credit." The great yearning for approbation looms large in all of us. Probably none of life's experiences is more bitter than the feeling of being deprived of deserved credit. Nor is any human failing more universal than that of thoughtlessly failing to give due credit to others. What motto, faithfully followed out, could net a man more than the paraphrase, "Millions for acknowledgments but not one wail for credit."

In every type of human contact the ability to assimilate people and to recall their names readily is a powerful instrument. It implies an interest and this in turn is complimentary to the individual; obviously he is rated as somebody. Endowments differ greatly and cultivation of the trait is only moderately successful with most of us. Both the self-satisfaction and the tangible benefits from the display of this ability are great, however.

Advice from the Side Lines.~In this engineering age a man without a firm grip on his bat is apt to be bewildered by loose talk from the bleachers. The following quotation will not be found in the Bible (or any place else): "Of him who doth deliver, much shall be expected." So in the present era—every weakness and every lack is chalked up against the engineer. "He gave us everything else, why doesn't he give us this; he made it, let him mend it and run it."

Perhaps instead of taking such irresponsible criticisms too much to heart we shall make our most useful contribution by simply continuing to do engineering things in an engineering way. It is indeed a compliment to the profession that it should be so much in the general consciousness, but that is no reason why we should be "kidded" into believing that our inherent capabilities are as limitless as an injudicious public might try to convince us they are.

There is no sound basis for the engineer to entertain an inferiority complex with respect to any other profession as regards either the nature of his work or the magnitude of its rewards. Engineering is freest of snobbery and false front; it is the least grasping and self-seeking; and the profession is practically free of the hypocrisy that so often makes a farce of vaunted ethical standards. What reason have we to begrudge the doctor his fees, the lawyer his headlines, or the politician his "gravy"? Let the actor have his spotlight and fleeting public acclaim; he needs them, we don't.

Other professions render personal service and even selfish members are likely to find professional advantage in participating in worthy and religious community enterprises as an aid in "building up a practice." The engineer's contacts are few and participation in such affairs must be for him an extracurricular activity necessarily free from elements of self-interest.

Superiority Without Disdain.~Granted that the members of the professions specializing in personal services do have acquired office mannerisms, which pass for culture, and a certain snobbish tendency to use words which impress but do not clarify; the fact remains that their breadth and depth of thought on current problems and their general culture probably average no higher than those of engineers.

Excessive advice may develop a protective layer like the shell of an armadillo or it may abrade to the quick, making one hypersensitive to each hairlike touch. Neither condition is desirable. To be wise is to be open-minded without being gullible, to be reasonably skeptical and rationally stubborn. Inspect critically but refrain from accepting any man's philosophy (even mine) until and unless you can make it square with your ideals, your observations, and your logic.

Why should the engineer become over-sensitive to the "blah" about being unsocial, a poor citizen, and a loafer in politics? To be a good citizen you must first be a good engineer. Then, probably, you may have to stand aloof. You are a member of a selected professional group. Mediocrity (simply meaning the medium or average) is upward for those at the bottom but for you it is distinctly downward. Your "neck is out" and your head is a target for snipers. Tall men must accept hazards that don't bother dwarfs. For you the comforts of mediocrity are available only if you stoop or shrink to the average level.

The Profession's Internal Problems.~Of lawyers the public has always been just a bit suspicious; they must operate in sets of three, one to prosecute, one to defend, and a judge to watch the two of them. Of recent years the public has not trusted its doctors quite as implicitly as it once did; and there are reasons for this.

In spite of occasional expert-witness episodes, the engineer still holds to a remarkable degree the confidence of his public. He continues often to occupy, satisfactorily to all concerned, the anomalous position of arbiter where the interests of his employer are in conflict with those of others. If the engineer is to continue to merit such confidence he must cherish, as something not to be profaned, his reputation for stalwart, uncompromising honesty. He needs to be especially critical of those ventures which are placarded as "for the public good."

Powerfully organized, skillfully manipulated, pressure-group action has become universal, fully respectable, and even vested with saintliness if the cause is worthy—and what cause isn't worthy when its protagonists need money? In addition practically every organized professional group is pushing to multiply the employment and boost the fees of its constituency.

Thus far engineers have probably been less grasping than other professional groups. There is considerable force to the contention, however, that we too will be compelled to squeal and crowd for our place at the trough or else reconcile ourselves to the inevitable fate of a well-mannered hog.

Above all, Integrity.~Perhaps we too shall soon be applying the same formula as every other union whether it be called the C.I.O. or the A.M.A. When and if we do those things that run up the cost of a given service to our clientele by imposing artificial restrictions on output, we will have sacrificed a heritage which until now has been sacred to the engineering tradition. How sturdy are the ethics of this our profession? Will it, like all the others, rush for the exits, trampling under foot those who are less robust? Or will it choose to adhere to its traditional standards, being consumed by the flames, perhaps, but with shoes unmuddied by the muck of human flesh and blood?

The future of all of us, young and old, is charged with opportunities, but it is surcharged with problems that involve both ethics and engineering. We must meet situations calmly and critically as they arise, refusing to be stampeded by any man's ready-made or superficial philosophy. We must elect "queerness" in preference to mediocrity and endeavor to get the most out of each experience that comes our way.

If we will locate our triangulation points on the mountain tops, and adhere to our engineering techniques, we can map out a career of which we need not be ashamed, no matter how rough the terrain.

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Concrete Mixing and Placing on Large Dams
I. Organization and Equipment

Modern Methods and Costs—Aggregate Selection to Curing

By Adolph J. Ackerman
Member American Society of Civil Engineers
Director of Engineering, Dravo Corporation, Pittsburgh, Pa.

UP-TO-DATE information on costs and procedures for the complete range of activities concerned in the great construction projects of the present are rarely brought together in the connected and informative way achieved in this paper. Mr. Ackerman has devoted the better part of a year to careful selection of the data and comparisons assembled here.

SELECTION of proper construction plant is the most important step in building a large dam. Once the correct plant has been erected the job is virtually half built, and further operations generally fall into a well-defined routine. For each job one plant layout is usually the best and most efficient; its selection requires a thorough analysis and proper correlation with respect to time schedule, labor rates, river handling, topography, and similar local controlling factors. If an error has been made in plant selection it usually costs more to correct it than to continue with the available facilities.

Job Planning. The first step is to break the job into stages that are most natural and economical with respect to handling of floods and construction of cofferdams, and that best fit the selected type of concrete placing plant and transporting facilities. There is usually one "best rate" or "natural rate" of construction for each job, and either a faster or a slower rate costs more. In Fig. 1 an attempt has been made to show graphically how certain variable costs on a large dam are influenced by the periods of construction. These variables are summarized along with the fixed cost to give the total cost of a project. This shows that there is a period of construction within which the job can be done at minimum cost. However, as will be shown later, an increased cost due to a reduction in time is frequently justified where such increase is recoverable by income from the completed project.

Since the construction plant usually is the biggest single investment on a job there is a tendency to "underplant," with the usual result that it is impossible to take advantage of unanticipated improved conditions or the "breaks." The plant must generally also serve a great variety of operations other than the placing of concrete. "It is better to overplant than to underplant" is an important principle among successful contractors.

The design of a concrete plant and placing system depends on: (1) general type of dam structure, (2) limitations in speed of construction due to type of structure, (3) required completion date, (4) topography, (5) river handling and climatic problems, and (6) economic rate of supply of aggregates from quarry, gravel pit, or other source.

These factors must be in proper balance but this does not mean that the necessary plant must be at minimum cost. Frequently a higher first cost will result in a reduced cost of other factors to spell a minimum total cost of project. For example, where it is feasible to use a cableway, its first cost may represent a greater investment, but at the same time it eliminates the need for a construction bridge across the river. Also it permits cofferdamming and river handling according to the most economical design and schedule. There is less necessity for coordinating this with concrete placing operations than if cranes are run on the cofferdam, and concrete can be placed at a large number of points from the start.

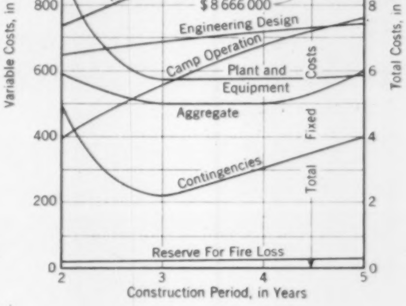

Fig. 1. Effect of Construction Period on Costs

The supply of aggregates and cement, and mixing, transporting, and placing of concrete are usually interlocked so as to represent a single operation and will be discussed in that order.

Aggregate Supply. The location of suitable aggregates has a major influence on the general economics and feasibility of a concrete dam project. Under favorable circumstances natural gravel and sand deposits are available nearby in the river bed, and, after necessary processing and screening, are carried by belt conveyor direct to the mixing plant. If such deposits are not within economic transporting range, rock from excavation or other acceptable formations must be quarried, crushed, and screened. It is feasible to produce manufactured sand from quarried rock with quality, gradation, and particle shape superior to many natural sands.

To minimize segregation and maintain consistent uniformity of the concrete mix, coarse aggregates are separated, stored, and batched on most large jobs in four sizes: 6 to 3 in., 3 to $1^1/_2$ in., $1^1/_2$ to $^3/_4$ in., and $^3/_4$ to $^1/_4$ in. Sand ranges from No. 4 sieve down. In natural materials the typical cost of all sizes is about 50 cents a ton. In manufactured aggregates the coarse sizes run to 50 or 60 cents a ton, and sand about $1.00 a ton.

Regardless of method of aggregate delivery—whether by railroad, truck, tramway, or belt conveyor—usually large terminal storage piles are provided adjacent to the mixing plant, so that shutdowns in the production of aggregates, which may run into several days, will not interfere with concreting operations.

Cement Handling. Cement is customarily handled in bulk in hopper-bottom railroad cars which discharge directly into a cement pump, an air-activated conveyor, a screw, or a bucket elevator for raising it into silos. Where cement is delivered in box cars a special type of portable compressed-air unloader, similar to a vacuum cleaner arrangement, is used to pump the cement directly into silos. Enough storage capacity in steel silos is usually provided to take care of cement needs for several days, depending upon the proximity of cement mills. Cement handling costs range from 9 to 13 cents a barrel. Trucking of cement from the railroad to the job is a very common operation for hauls of 15 miles or less, but sometimes even longer distances can be trucked economically if traffic and other conditions are favorable.

Mixing Plant. The capacity of a mixing plant should be about 20 to 25% above the average rate of expected output for the period of the job. In designing a mixing plant a detailed cycle in minutes and seconds of batching, mixing, transporting, and placing of concrete must be developed to define the interlocking operations of each component of the plant. A mixing plant is usually equipped with a single set of individual weigh batchers, one for each ingredient of the mix, and with the following arrangements of mixers, the choice in any instance depending upon the required output and desired size of batch for subsequent handling: 2 or 3 two-yard mixers; 2, 3, or 4 three-yard mixers; 3, 4, or 5 four-yard mixers.

High-efficiency mixing plants are now available as standardized units for various capacities and can be purchased as readily as cranes or shovels. Mixers are generally tilting and of either the rear or front charging type. Because performance requirements overtax human ability in operating the controls, a full automatic batching plant is the most efficient for the larger plants. Mixing of concrete costs around 25 to 35 cents a cu yd. A typical mixing plant, consisting of three 3-cu yd mixers, costs about as follows:

Foundations	$ 5,000
200 tons of structural steel erected	25,000
Batchers	15,000
Mixers	24,000
Miscellaneous	2,000
Installation costs	5,000
Total	$76,000

The price for a two 2-cu yd mixing plant with 115 tons of structural steel runs about $50,000, ready to run.

Transfer of Concrete. Concrete is generally transported from mixing plant to placing equipment in bottom-dump concrete buckets on flat cars, or in special cars discharging into bottom-dump buckets suspended from cableways. Expeditious handling of concrete is essential and a dependable system of dispatching is ordinarily part of an efficiently managed job. Belt conveyors are suitable for transferring concrete between two fixed points, provided the loading and discharge ends are properly designed to overcome segregation; they are ordinarily not satisfactory for the distribution of concrete into forms. For combined transfer and distribution, a concrete pump has been used more successfully. This type of equipment has a capacity of 50 to 60 cu yd per hr and can deliver concrete a distance of 1,000 to 1,800 ft.

Forms. The most common type of form has been a prefabricated panel with horizontal anchorages at the lower edge and inclined internal struts and tie-rods supporting the upper edge and anchored to the previously placed concrete on an angle of about 45°. Many efforts have been made to develop steel panels for large dams, but it has never been found feasible because of their weight and the difficulty of attaching keyway forms, reinforcing steel, or other types of inserts. The double-row type of panel set-up has given way to the single-row sliding type of panel, largely because of greater economy and simpler handling. It is possible to raise the sliding type of panel with small manually operated hoists, thus eliminating the need for using the main concrete placing cranes for handling forms. A typical panel 10 ft high by 26 ft long weighed about 5,000 lb; another 5 ft high by 48 ft long weighed 8,500 lb.

The cantilever-type form, eliminating internal tie-rods, has been tried several times, but where large buckets were used the impact of discharging concrete has usually caused misalinement. However, on several recent jobs, notably Mahoning and Shasta dams, this type of form has proved feasible from a practical standpoint.

Placing Equipment. For placing the concrete, either cableways, whirlers, or hammerheadcranes, with bottom-dump concrete buckets, are standard equipment. Where large volumes of aggregate are processed and handled for massive structures, the intermediate sub-

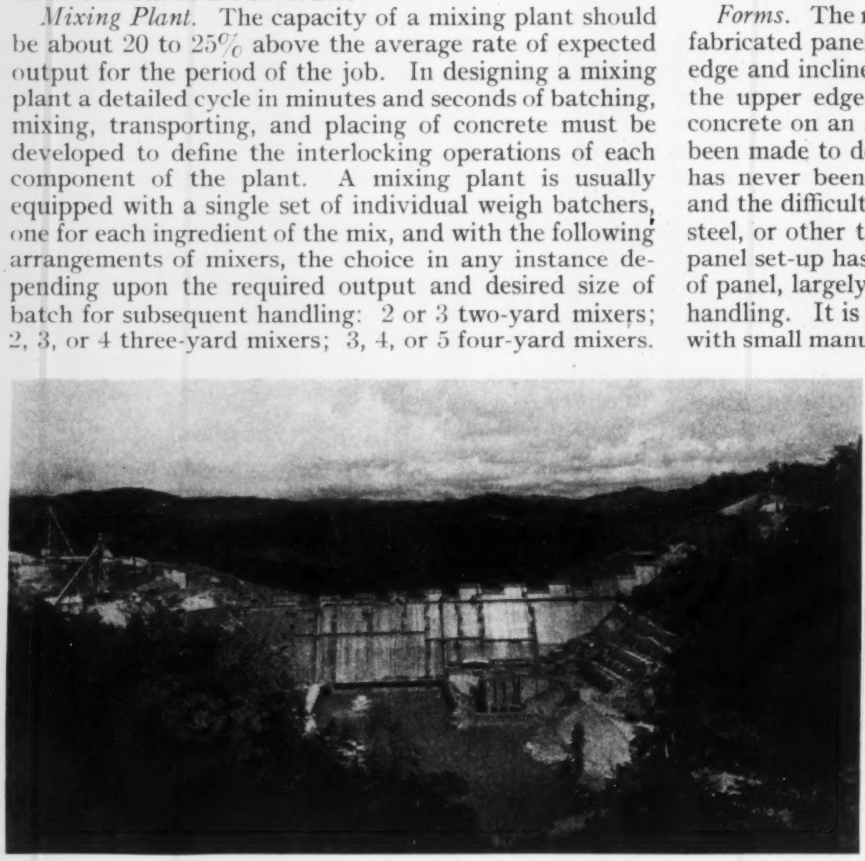

FIG. 2. PLACING BY CABLEWAY PERMITS ACCESS TO ALL PARTS OF CONSTRUCTION AREA
Hiwassee Dam Nearing Completion in September 1939

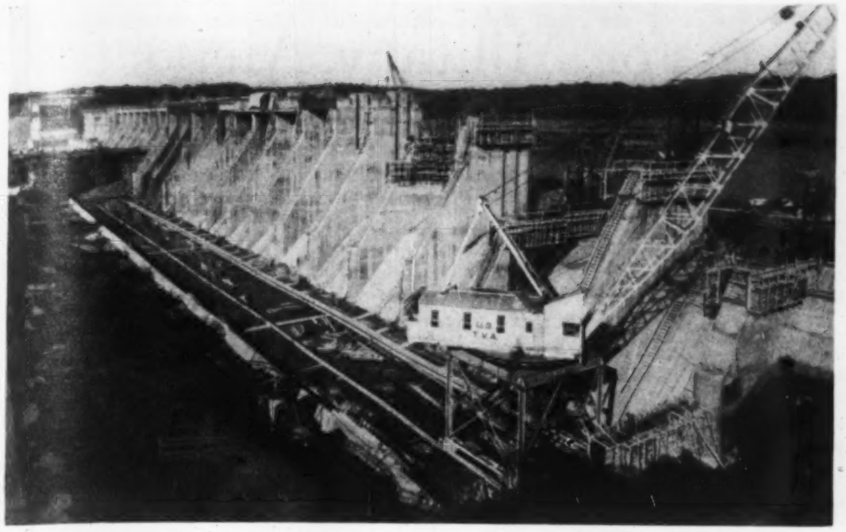

FIG. 3. WHIRLER CRANES PLACE CONCRETE ON PICKWICK LANDING DAM
Cranes on Runways Are Considered More Economical for Long Dams

dividing and recombining processes should not be carried any farther than necessary; in other words, the larger the project the greater should be the capacities of the placing equipment.

The largest placing unit for canyon-type dams is the 25-ton capacity cableway with an 8-cu yd concrete bucket. This has been used on free spans up to 2,600 ft. The introduction of lock-coil track cable and traveling steel towers with horizontal-thrust wheels has extended the use of such cableways, and where the size of the project and topography are favorable, a cableway is the most economical (Fig. 2). Its chief advantage is that once it is erected, all parts of the project are immediately accessible to a large-capacity hook, and the entire project can be completed without further changes in construction plant. Its higher first cost over standard smaller-capacity cranes is recovered in reduced operating expenses throughout the period of construction because smaller cranes mean smaller concrete buckets, more hooks, and more signal men, more placing crews, more transfer trains and crews, and more general maintenance of machinery. On smaller canyon-type dams, one or two 10-ton capacity cableways may be more economical with 4-cu yd buckets. A 6-cu yd cableway is sometimes used but this size is less conventional practice.

The whirler crane is best adapted to wide river dams, navigation locks, and similar spread-out projects. In most cases it is necessary to provide steel trestle runways across the site (Fig. 3). The 5-ton and 10-ton capacity whirlers, using 2-yd and 4-yd concrete buckets, respectively, with booms up to 125 ft long, are the most standard sizes. The 3-yd size is less conventional and ordinarily does not fit available buckets or transfer and mixing equipment.

The interrelation of whirler cranes, transfer and placing crews, and the number of each requires detailed study to establish the combination which will give the lowest unit costs. The results of such a study are indicated in Fig. 4. These show how the cost goes up as output and operating efficiencies decrease. For best performance the plant must operate at full capacity for as long a period as possible, and the inevitable interferences of other operations must be coordinated into the work with least possible adverse effect on the continuity of the work.

The Grand Coulee Dam called for a new type of placing system—hammerhead cranes handling 4-yd buckets and running on long steel working trestles. Such cranes may be considered special units for conditions where the swinging boom of the whirler (which can cover the same area) introduces an unfavorable operating condition and loss of time in each cycle.

Compacting and Curing Concrete. Concrete is almost universally vibrated in place with immersion-type vibrators, which are particularly necessary because modern concrete is placed quite dry, having only about $^1/_2$- to 1-in. slump; however, the resulting concrete is of superior quality and ordinarily has a compressive strength around 3,000 lb per sq in. at 28 days with 0.85 bbl of cement per cu yd. Curing follows conventional practice in keeping the concrete moist for extended periods and controlling the heat of hydration by means of embedded refrigeration lines. The cleanup of construction joints has also become exceedingly important and usually requires sandblasting and other abrasion methods to develop an effective bond between previously placed and new concrete.

Cost of Concrete. "What is the cost of concrete?" is the same type of question as "What is the price of wheat?" Unit costs within the range of useful accuracy require consideration of many local factors. Furthermore they vary depending upon the nature of the work, as indicated by the following figures, whose significance, of course, is purely relative.

Heavy mass concrete in dams runs about $5.50 per cu yd including all materials, plant, and labor. Low dams of massive type and lock structures cost $8.00 to $9.00 per cu yd. Power-house substructures highly reinforced and with special forms cost $15.00 to $22.50 per cu yd. Superstructures with a great amount of detailed form work and very difficult placing cost $50.00 to $60.00 per cu yd. Piers on dams and in other structures differ widely in both form and function and vary in cost from $14.00 to $40.00 per cu yd.

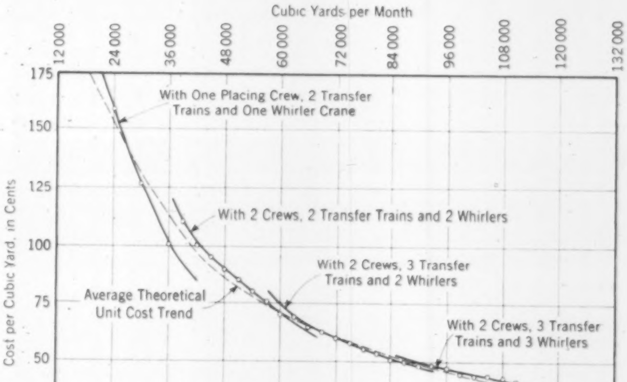

FIG. 4. PLACING COSTS FOR VARIOUS OPERATING COMBINATIONS WITH WHIRLER CRANE

(In a second article to appear next month, Mr. Ackerman will present comparisons of construction rates and costs on more than fifteen recent large dam projects.)

Protective Designs for Military Airports

Possibilities in Air-Raid Cover and Concealment Suggested for Vulnerable Landing Fields

By LeRoy M. Hersum
Member American Society of Civil Engineers
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Awareness of the power and reality of destructive bombing raids and their threat to American institutions has come slowly to this relatively protected continent. Technical magazines in foreign languages, however, in recent years have devoted many pages to intimate descriptions of engineering works born of modern warfare. Now that our own interests demand a demonstration of military strength, the civilian engineer is challenged not merely to keep pace with foreign developments but to assimilate, anticipate, and surpass them. In the present paper, Mr. Hersum has achieved that freedom from slavish adherence to precedent that must characterize all our defense thinking if we are to succeed in time.

An airport for military and naval purposes must have protection if there is to be any hope of its surviving a military action. Protection may be provided by combat planes located at the airport, by planes at a sub-airport located within a supporting distance, by anti-aircraft artillery, by concealment and camouflage, or by bomb-proof shelters. The term shelter implies cover for ships, commanding personnel, operating personnel, and airport equipment. The importance of such considerations is emphasized by the German attacks on Polish, Belgian, Dutch, and other fields. Ordinary hangars are readily destroyed by fire. The possibility of sabotage and the ease with which such operations may be carried out should also be matters of concern.

An airport located in a terrain generally flat or nestled in flat areas between hills is probably harder to find than one adjacent to some large river or bay on an elbow or point of land as so many American airports are. Again, most American airports have their administrative buildings, hangars, and other operation facilities including gasoline tanks, grouped or set in a line that presents a perfect target once the airport is found.

Existing American airports are extremely vulnerable to an aggressive attack in force from the air; and even if only one or two planes succeeded in getting the attack home, the large number of planes in a hangar or in adjacent hangars of steel construction could easily be destroyed. If a full-scale attack should be launched first from one direction and then another, and possibly a third or fourth, the limited number of anti-aircraft guns available would have great difficulty in fending off all enemy planes. There is also the possibility of a single light bomber or attack plane getting through. With the high fire hazard which characterizes present-day American airports, the single plane might have success. The possibilities of sabotage by fire, set bombs (explosive or incendiary), gassing, or other expedients should also be recognized and guarded against.

Ordinary civilian airport design is characterized by a high degree of concentration for economy of operation and by a conspicuous lack of camouflage, fire protection, or dispersion. The disadvantages of this type of design from a military standpoint are readily apparent. The construction of numerous civilian airports may not

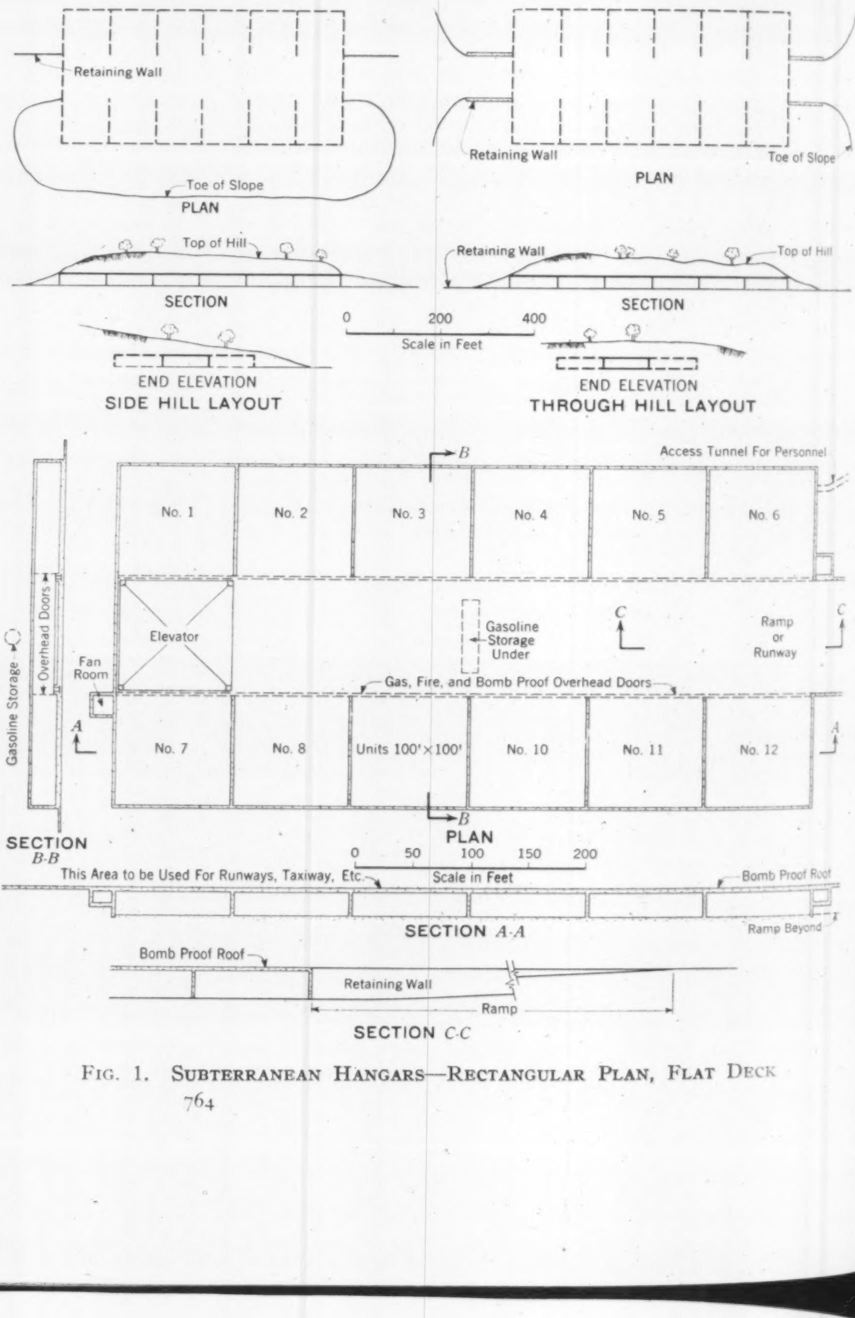
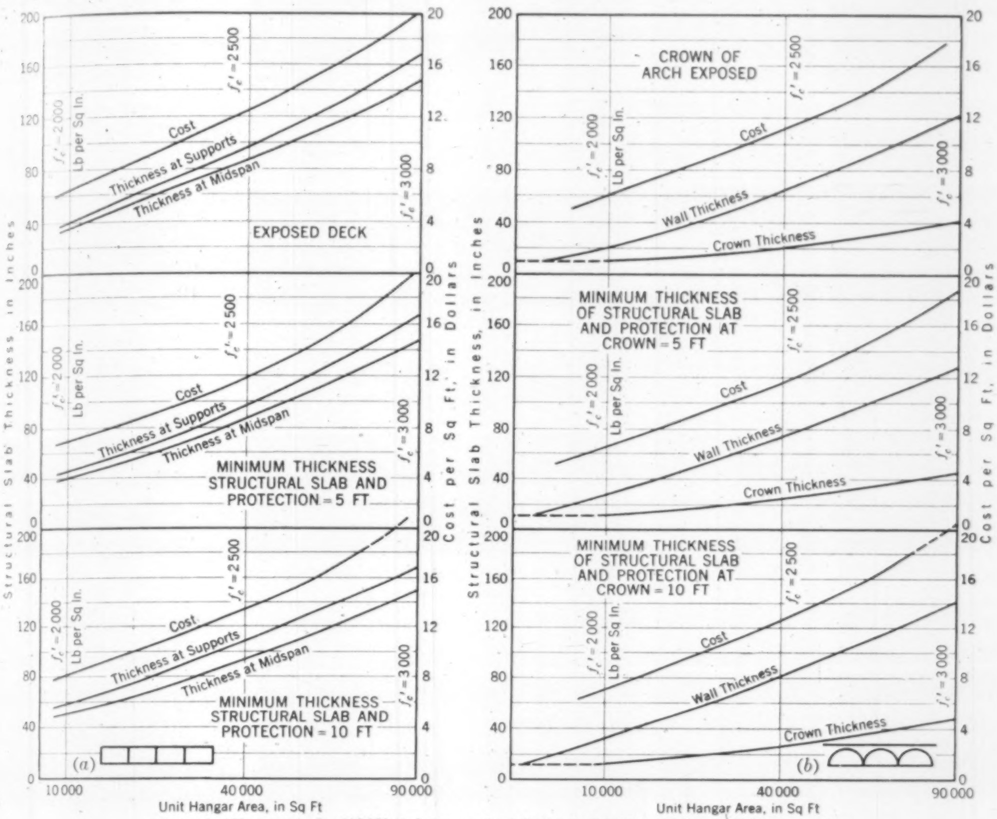

Retaining Wall
Toe of Slope
PLAN
Top of Hill
SECTION
END ELEVATION
SIDE HILL LAYOUT
Retaining Wall
Toe of Slope
PLAN
Retaining Wall
Top of Hill
SECTION
0
200
400
Scale in Feet
END ELEVATION
THROUGH HILL LAYOUT
B
Access Tunnel For Personnel
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
Overhead Doors
Gasoline Storage
Elevator
Fan Room
Gasoline Storage Under
C
Ramp or Runway
C
Gas, Fire, and Bomb Proof Overhead Doors
A
No. 7
No. 8
Units 100'×100'
No. 10
No. 11
No. 12
A
B
SECTION B-B
PLAN
0
50
100
150
200
Scale in Feet
This Area to be Used For Runways, Taxiway, Etc.
Bomb Proof Roof
SECTION A-A
Ramp Beyond
Bomb Proof Roof
Retaining Wall
Ramp
SECTION C-C

Fig. 1. **Subterranean Hangars—Rectangular Plan, Flat Deck**

be an advantage, except to the enemy, unless these airports can receive proper protection. They merely invite a landing, just as a good undefended harbor offers tempting anchorage to an enemy fleet.

All this then leads to the question of what may be done about it. Basically the idea of facilities for placing the light pursuit planes in the air from protected hangars is sound. Heavier planes would not be rushed out for local defense, and these therefore require protection only. Personnel also require bomb-proof shelters; and of course all anti-aircraft artillery which is available should be in protected positions if possible. Pursuit planes should be at runway level, and they should be able to warm up in bomb-proof shelters and take off with the greatest possible speed, in the dark as well as in daylight.



Live Load = 125 Lb per Sq Ft + 100 000 Lb Concentration at Center; $f_c = 0.45 f_c'$; $f_s = 20\,000$ Lb per Sq In.; $n = 15$

(a) Two-Way Slab Rigid-Frame Cover (b) Semicircular Filled Arch Cover

FIG. 2. COST ESTIMATES FOR RECTANGULAR-PLAN HANGARS

Includes Concrete Frame, Walls, Floor Slab, Fill, Damp Proofing, and Excavation; Excludes Foundations, Doors, Runways, Elevators, and Equipment

SPECIAL DESIGNS NEEDED

The advantages of special design for military and naval air bases have been recognized by Germany in the base at Wirtheim. There the principles of protection, concealment, dispersion, and camouflage apparently have been worked out in great detail. If Germany has found it worth while to take these precautions for the safekeeping of valuable planes, the United States should at least give this matter very careful study. It may be noted that the Coast Artillery still takes great pains in concealment, protection, and elimination of shadows, and other possible means of identification for fortified points whose ground location is well known.

Protection of a large base by concealment is a difficult matter. Painting might be helpful. Colored concrete could be used to blend with the surroundings. Steel grating runways with grass growing through them have been used at British airports. All markings, signals and lights should be so designed that nothing would show if hangars were bombarded. Natural camouflage by planting trees, shrubs, and grass would also help; the arrangement in symmetrical and mathematically precise lines along a rectangular road system would not. The type of runways and the general landscaping should have careful consideration.

Careful dispersion of all facilities, such as storehouses, homes, and quarters for officers and men not on duty, recreation grounds, and hospital buildings, is desirable; in other words, only the essential structures, equipment, and men should be at the field. Dispersion can be carried further by the construction of sub-bases within a supporting distance. The use of one field for training and routine flying with exposed runways which probably would be bombed during an attack, with another escape field or fields and sub-bases without formal runways held in reserve for use during attack is another method.

Anti-aircraft artillery in concealed and protected positions is, of course, desirable. The best defense, however, is the provision of pursuit ships located at the base or sub-base, provided they can get aloft rapidly, and provided there is an adequate warning system with efficient personnel.

FIGHTERS TO SUPPLEMENT BOMB-PROOFING

Bomb-proofing is essential for equipment that is difficult to replace. Heavy structural frames may be employed, with unit cells for one plane or for one flight. A more protected installation may be constructed with a natural surface to conform to surrounding terrain over a burster course and sand cushion and a layer of shatter concrete above a structural slab. The heavier type naturally is much more expensive. Although it would, at present, protect against the heavy bombs, there is always the possibility that larger bombs will be developed. Bomb-proofing against incendiary and light bombs seems to be a reasonable requirement. This type of bomb-proofing would admit the loss of one or more cells if hit directly by the heavier armor-piercing or delayed fuse type of bomb. The bomb-proof shelters may be covered artificially or tunneled into adjacent hillsides.

An adequate warning system coordinated with protecting planes is the best defense. A coastal air base would have limited time, in any event, to warm up planes to take the air. Provision should be made for concealed and protected runways. Possibly, also, a down grade or some means of initial acceleration or catapulting of planes could be used. The concealed runway with planes emerging at approximately flying speed would certainly give the best results.

Pursuit planes from sub-bases within a supporting distance or from other bases would be most helpful if there is a chance of driving the attack off. On the other hand, it might be desirable not to sacrifice pursuit ships against overwhelming odds but to hold them in the shelters and trust the anti-aircraft to prevent the heavy enemy bombers from getting too close. This, however, would be a very negative defense.

Heavy planes of the bombing or flying-fortress type would not attempt to take the air in the event of a surprise raid. For these, reasonably well-protected concrete bomb-proof shelters appear desirable. Such shelters would have gasoline and water pumps, air-conditioning equipment, individual power plants for light and heating, and fire and gas protection. If the area is generally flat, the most efficient type would be a buried hangar with individual cells and elevators, ramps, and runways for exits and entrances.

Depressed or buried hangars, or hangars with roofs used as runways could be constructed by methods now used for subway work. Walls and footing trenches are excavated and constructed first. The girders, beams, arches, and slabs are formed, erected, and poured; excavation work for the cells and corridors follows, and the final major operation is the paving of the floor slab. Drainage below the structures is provided for, and any water pressure properly resisted. Damp-proofing and water-proofing may be necessary. In certain locations hangars might be built above the general level and fill placed around and over to airport grade.

Only the necessary command and administrative personnel should be provided with quarters at the air base. Supply and record personnel ought to be stationed elsewhere. The command post should be heavily protected. Facilities should be available for observation with the minimum of danger, and there should be alternative locations nearby. Personnel should not all be located at one point, but should be dispersed as much as possible. Working details for all the services that will be needed during an attack on the base should have full protection.

Signal, telephone, telegraph, radio, and warning systems, including anti-aircraft communications, should be deeply intrenched; cables should be buried beyond all possible danger.

Only necessary gasoline, ammunition, and oil should be located in magazines and tanks below the hangars. Bulk storage for oil and gasoline could be located at a greater distance and piped to hangars. Repair shops for all work except that of a minor nature and all general storage should also be located at a considerable distance away from the hangars.

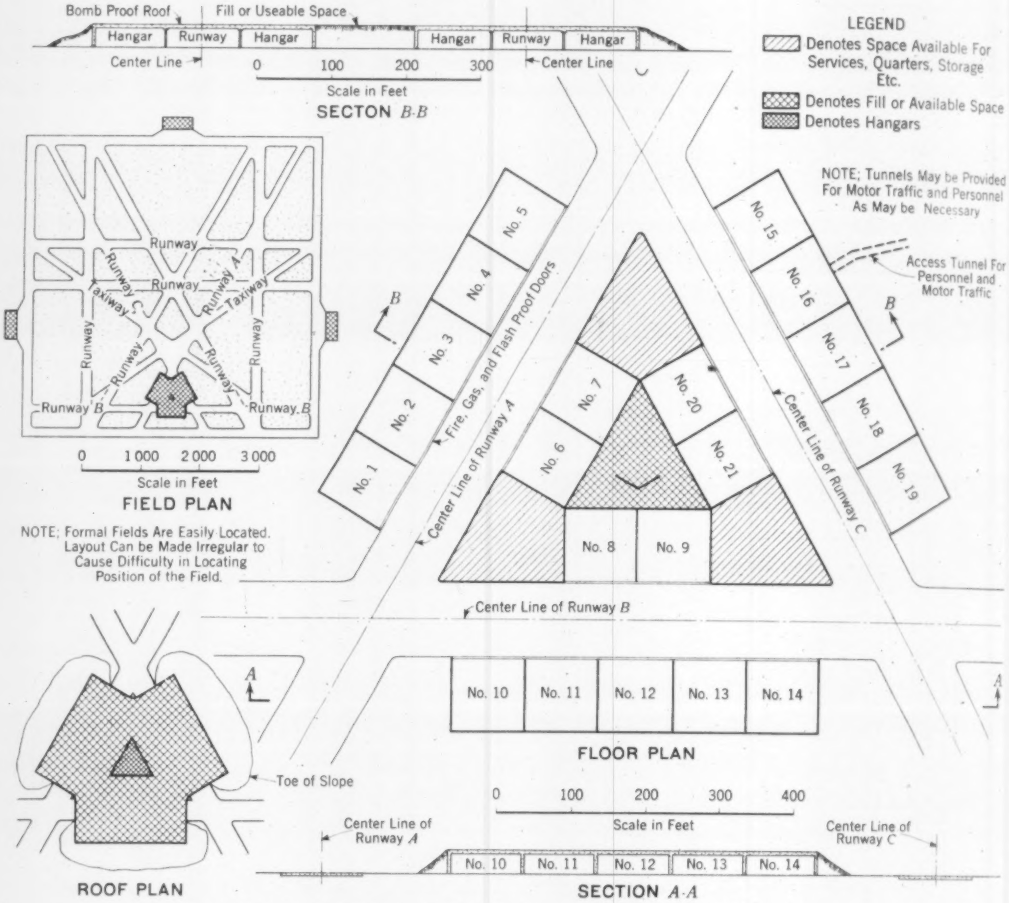

Bomb Proof Roof
Fill or Useable Space
Hangar
Runway
Hangar
Hangar
Runway
Hangar
Center Line
0
100
200
300
Center Line
Scale in Feet
SECTON B-B
LEGEND
▨ Denotes Space Available For Services, Quarters, Storage Etc.
Denotes Fill or Available Space
Denotes Hangars
NOTE; Tunnels May be Provided For Motor Traffic and Personnel As May be Necessary
Access Tunnel For Personnel and Motor Traffic
B
B
Runway
Runway
Runway A
Runway C
Taxiway
Taxiway
Runway
Runway
Runway
Runway
Runway B
Runway B
0
1 000
2 000
3 000
Scale in Feet
FIELD PLAN
NOTE; Formal Fields Are Easily Located. Layout Can be Made Irregular to Cause Difficulty in Locating Position of the Field.
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
No. 7
No. 8
No. 9
No. 20
No. 21
No. 15
No. 16
No. 17
No. 18
No. 19
Fire, Gas, and Flash Proof Doors
Center Line of Runway A
Center Line of Runway C
Center Line of Runway B
No. 10
No. 11
No. 12
No. 13
No. 14
A
A
FLOOR PLAN
Toe of Slope
ROOF PLAN
0
100
200
300
400
Scale in Feet
Center Line of Runway A
Center Line of Runway C
No. 10
No. 11
No. 12
No. 13
No. 14
SECTION A-A

FIG. 3. TRIANGULAR LAYOUT FOR UNDERGROUND UNITS
For Limited Number of Cells

Obstacles to the landing of enemy planes have been suggested. Although their value may be questioned, barricades might be constructed to rise on signal in various sections of the airport and cause a plane to crash over in landing. Mining is also a possibility, provided it does not present an opportunity for sabotage. Spring traps are perhaps a far-fetched idea. The use of stone fences which can be lowered flush with the ground might serve two purposes: first, to deny use of the area for landing when they are raised and, second, to constitute an easily removable camouflage.

Where hangars or buildings to be defended are grouped together and are more or less easily identifiable, ground defense should be localized. In areas where the objects to be defended are scattered and are less easy to identify from the air, defense should be distributed. In order to fend off dive bombers, the light "AA" guns should be located on top of the hangars for pursuit ships if the runways or structures are visible from above. The heavy bombers which release bombs from 10,000 to 20,000 ft up and a mile or more away can only be warded off by heavier "AA" guns located under the area in which the bombers would line up on the air base. Machine guns for defense against light enemy tanks should be located around the field and at the hangars for pursuit ships. Disappearing searchlights could be used, and sound

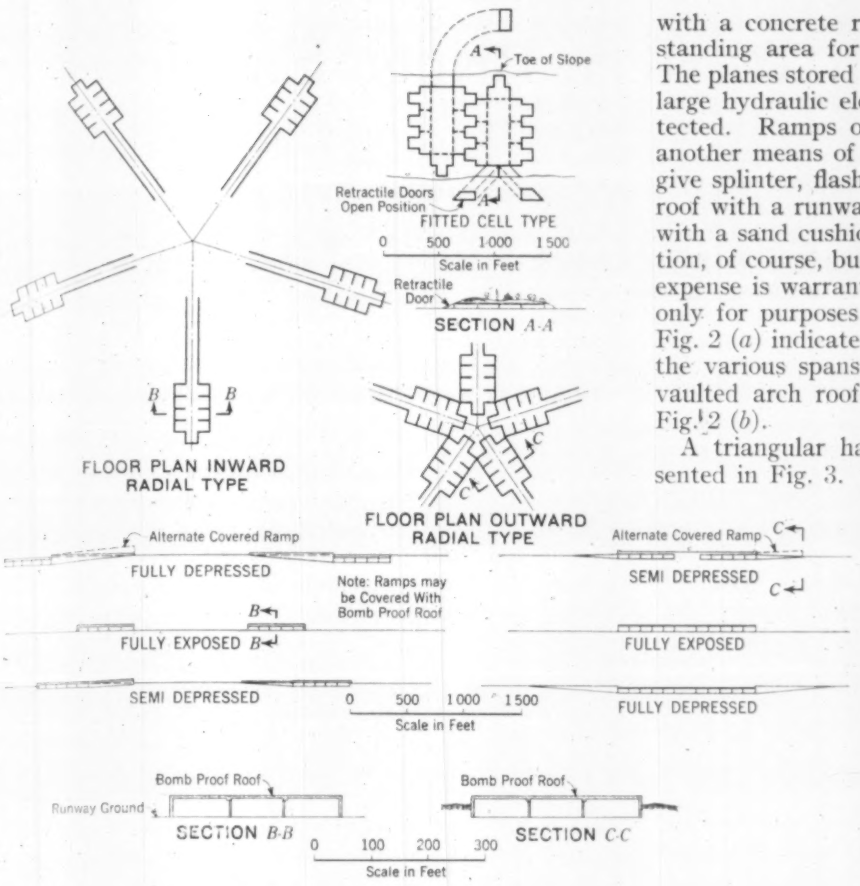


Fig. 4. Hangar Cells Scattered to Suit Terrain

ranging equipment should be available. Disappearing control and signal towers might also be advisable.

If large bomb-proof hangars are not available, the largest planes should be stored well back from the coast, and brought up to the coast for refueling before starting a mission from the shore. If necessary a separate airport for extremely large bombers or separate shelters for each plane with heavy motor-operated doors could be constructed. The usual materials for the construction of a fireproof hangar are steel, concrete, and brick. Ordinary small-bridge construction of concrete runs up to spans of several hundred feet and is adaptable to this type of building. Simple slabs; continuous slabs; T-beam roofs; two-way construction, slabs, or beams; rigid-frame types, one- or two-way; full-center arches; groined arches; flat tied arches—these are the familiar structural elements that would be used.

It should be taken for granted that any structural steel will be fireproofed; hence all work, except for the heaviest and largest spans, will be automatically surfaced with brick or concrete. The long spans supporting panels over cell and corridor openings may be of steel girder, truss, or arch type, protected by fireproofing. Many examples of the efficiency of reinforced concrete construction in resisting bombing have been noted. Stresses arch around a hole caused by a falling bomb; and the structure, if carefully designed, does not fail. Light structural steel frames appear much more vulnerable to both fire and explosion.

POSSIBLE CONSTRUCTION SCHEMES

To illustrate the possibilities and needs of the subject, and to stimulate further thought along similar lines, a number of specific schemes have been prepared and studied. The first of these, Fig. 1, is a sunken hangar with a concrete roof. This roof could be part of the standing area for planes or part of the runway area. The planes stored within reach the surface by means of a large hydraulic elevator, the roof of which is also protected. Ramps or runways at the ends would afford another means of egress. Overhead doors in each unit give splinter, flash, gas, and fire protection. A heavier roof with a runway slab acting as a burster course and with a sand cushion below it would give greater protection, of course, but it is doubtful whether the additional expense is warranted. The span of 100 ft is suggested only for purposes of comparative study. The data in Fig. 2 (*a*) indicate approximate costs per square foot for the various spans. Costs for a similar plan but with vaulted arch roofs and groined corridors are given in Fig. 2 (*b*).

A triangular hangar, also for pursuit ships, is presented in Fig. 3. It is much smaller than in the third study. This is a relatively small installation with provision for exits in six directions at flying speed and bomb-proof and incendiary-proof shelter. The field plan shown is perhaps so formal that it would be easily located unless pains were taken to make it more irregular. The hangars at the sides of the field are for observation and bombing planes which would not take to the air if the airport were attacked. These hangars are buried or concealed as much as possible.

A landing field with sunken hangars radially located is illustrated in Fig. 4. Each hangar in turn has a ramp up or exit toward the center or radially outward from the center. Over the exit doorways, anti-aircraft guns could be located to guard the most vulnerable points. Elevators or covered ramps could be provided at the far end of the hangars as emergency exits, if desired. Otherwise, the general scheme of individual cells forming a hangar has been carried out. A small detail at the top of the drawing shows the "fitted cell type." This could be used for the larger planes with some economy. The exit door could be designed to match the surroundings on the outside face. Single large cells for one plane alone, with light doors, not bomb-proofed, would provide shelter at separate points.

The several disadvantages for bomb-proof shelters are the lack of flexibility, the reduced number and size of entrances and exits, and the difficulties of ventilation and servicing. If the units were designed to fit one type and size of plane only, they could not provide shelter for larger planes, and new shelters would have to be constructed. If planes were damaged at the exits or entrances, they might block the entire section and prevent the exit of other planes badly needed. Air conditioning and gas protection are expensive. The costs of fire protection, bomb-proofing, and long spans of heavy construction are much greater than for light hangars on the surface. If ledge is encountered, an additional expense in construction is incurred. If cliffs near the airport could have arched openings, the cost might be lessened.

Initial protection should be given airports on the coast and those just back of the coast. Advantage should be taken of all natural camouflage that is available. This does not mean that the airports farther back should be unprotected. All should receive similar attention at the earliest feasible moment, but the coastal and more exposed distant bases should come first.

Developments in Western Bridge Engineering

By Maurice Housecroft

Associate Member American Society of Civil Engineers

Chief Bridge Engineer, Utah State Road Commission, Salt Lake City, Utah

PROGRESS and problems go hand in hand; to achieve the first the engineer must conquer the second. In so doing he must recognize changing factors. For example, the road roller, long the standard of highway loading is now superseded by massive truck-trailer units. California discovered one dual-axle load of 42,000 lb, and such vehicles travel interstate. In attacking these difficulties, engineers are making better concrete; utilizing special alloys and special steel shapes; developing continuity in structural design; and improving construction through modern mechanical equipment. Mr. Housecroft's paper was presented before the Highway Division at the Society's Denver Meeting.

PROGRESS demands that natural obstacles be surmounted. Even in the past few years our engineering achievements indicate that the limit of our abilities is far beyond our present attainments. Valleys have been spanned and foundations sunk to distances formerly considered unattainable. Thus we attack the tremendous task. However, our problems are not all concerned with mammoth structures—many relate to so-called small structures each of which presents its individual problem. Every structure, whether large or small, combines the efforts of many human heads, hearts, and hands in utilizing science, craftsmanship, and materials to produce another link in the chain of modern conveniences.

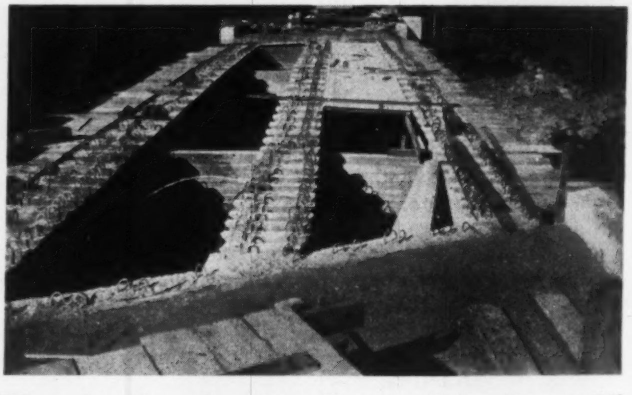
Marked increases in traffic frequencies and speeds, and in the size of transportation units have demanded improvement in highway engineering standards to accommodate these developments with safety. The day is long past when highway alinement was sacrificed to obtain cheaper bridge sites. Long-radius curvature, increased sight distances, wider roadways, and easy grades for present-day bridge approaches, tend frequently to complicate modern bridge location and design.

Many bridge engineers now in active practice can recall the time when the road roller was considered the heaviest concentrated live load. However, with the coming of motor transportation, loadings were adjusted to fit the new units and the now well-known "H" loadings of the American Association of State Highway Officials were evolved. These are of three classes, H-20, H-15, and H-10, the H-15 and H-10 loadings being, respectively, 75% and 50% of the H-20 loading.

It may be mentioned that each lane of loading consists of one truck, of the indicated gross weight in tons, followed by, or preceded by (or both), a line of trucks of indefinite length. Each of the other trucks has a gross weight of $^3/_4$ of that characterizing the loading class. Axles are assumed to be 14 ft apart, with an interval of 30 ft to the nearest axle of an adjacent truck. Equivalent loadings have been developed for loaded lengths of 60 ft or greater. For the H-20 class, these consist of a uniform load of 640 lb per lin ft of 9-ft lane and concentrated loads of 18,000 lb for moment and 20,000 lb for shear. A proposed revision contemplates increasing the width of lanes to 10 ft.

The growing use of truck trailers has caused considerable apprehension among bridge engineers. To care for these heavier loads the "S" loadings —S20-16 and S15-12, the latter 75% of the former—have been developed. The typical design unit is similar to the truck tractor semi-trailer unit in which the semi-trailer axle is 14 ft from the truck tractor's rear axle and has the same load on each of the rear axles as the rear axle of the truck in the H-20 loading. In the equivalent loading, the uniform load is similar to H-20 but concentrations for moment and shear are increased to 32,000 and 40,000 lb, respectively. The "S" loading, of comparatively recent development, has not yet been widely used in the West.

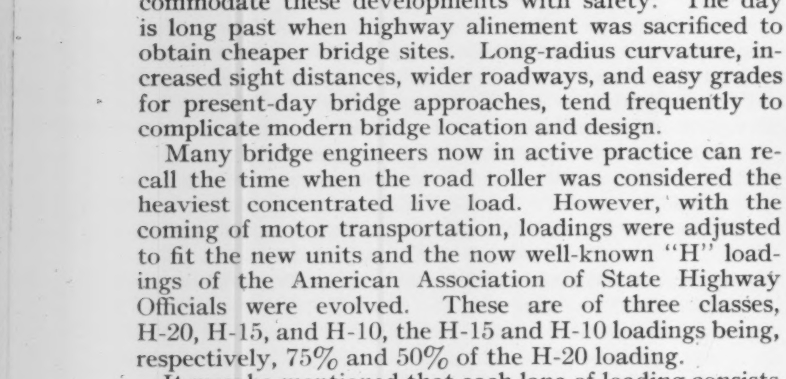
Because of the wide variation in the several types of transportation units, which range from a 2-axle truck as a single unit to a 6-axle truck-and-trailer combination, it became necessary to develop a formula that would reflect, in terms of vehicle lengths, the total safe permissible load without creating stresses far in excess of those induced by the typical unit used in the design. The late A. L. Gemeny, of the U.S. Public Roads Administration, pioneered the development of a formula: $W = 700\ (L + 40)$, in which W is the maximum limit of gross load in pounds, and L is the distance in feet between the first and last axles of the truck group or train.



T-Beam Span Built Over Provo River at Nunns, Utah, in 1926

Arrangements of Shear Keys and Stirrups Resist Horizontal Shear Along Plane Between Stem and Slab. This 75-Ft Span Probably Is First Application of Construction Principle Now Common Practice in Many States

Existing laws in the western states are not uniform on this important operating feature. In the interest of greater uniformity, a committee of the Western Association of State Highway Officials met with representatives of trucking associations at Reno, Nev., in August 1938. This joint committee recommended a modification of the formula for use in the western states. This modifica-



An Outstanding Vertical-Lift Bridge Over Sacramento River at Sacramento, Calif.

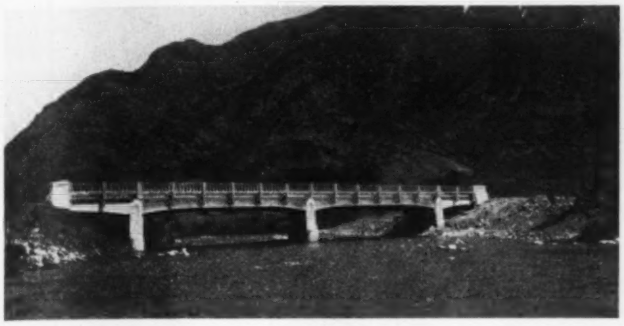
Received Honorable Mention in Class B for 1935 Award of American Institute of Steel Construction

tion was adopted by the Association. It is hoped that ensuing legislation will reflect the change for the benefit of transportation and the highway system as a whole.

In part the recommendation as to loads and lengths is as follows: length of single units, 35 ft; length of truck-trailer units, 60 ft; maximum axle load, 18,000 lb; and gross weight in pounds, 750 ($L + 40$), providing that the gross weight on axles within 18 ft does not exceed 650 ($L + 40$) lb. This reduction of load on axles within an 18-ft length is to prevent grouping of axle loads in short distances with resulting excessive concentration.

In general these legal loads will not induce serious overstresses in bridges designed for the H-15 loading. However, analysis has shown that certain span lengths and certain types of structures suffer more than others; for instance, in concrete structures where the dead load comprises a large percentage of the total, an appreciable increase in live load will not cause as much overstress as in some other structures.

California allows a 3-axle tractor and a 2-axle semi-trailer—a maximum gross load of 60,000 lb. Because of its generally short wheelbase, this vehicle produces excessive stresses; for the girders of a 60-ft span the live-load moment is 63% over that of the H-15 loading. In the case of shear, the design load is exceeded by as much as 55% on a 40-ft span. For the same length, the excess of live-load stress on floor beams or caps amounts to 67%.



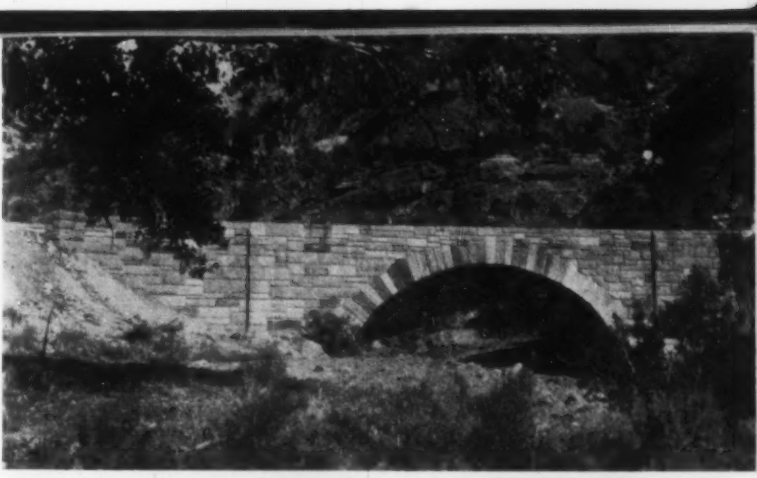
Weber River Bridge, Utah, Has Continuous Spans of Steel Rolled Beams

Parts of Lower Flanges Severed and Curved, Giving Additional Moment of Inertia and More Pleasing Lines

These figures refer to a vehicle of average wheelbase carrying the legal maximum load with no lateral unbalancing. California permits unbalancing of a 17,000-lb axle load to the extent of 10,000 lb on one wheel. If the shortest coupled 3S2 unit recorded by the California Highway Department's Planning Survey as carrying a full legal load were unbalanced to this extent, the live-load overstresses would amount to 120% in moment and 105% in shear.

Additional stresses induced by loads in excess of the legal maximum can only be surmised. It is axiomatic that those vehicle types which are allowed the heaviest loads most often exceed the legal restrictions. Although only 3.4% of all vehicles recorded by the California Planning Survey exceeded the gross load restrictions of the Vehicle Code, 28% of the type 3S2 vehicles, and 26% of the type 3-3 vehicles, were operating in excess of legal maximums. Actually, the Planning Survey recorded single-axle loads up to 26,000 lb and a combined load on a pair of dual axles as high as 42,000 lb.

On the other hand, it must be noted that these percentage figures refer to live-load stresses only. The actual stresses exceed those produced by the H-15 load by varying amounts, depending on the ratio of live to dead load in the particular type of structure. For steel structures of medium span, the actual overstress would be on the order of half the given percentages; for concrete structures somewhat less.



Local Varicolored Rock Used in Pine Creek Bridge, Zion Park, Utah

These overstresses are not considered dangerous in our recent bridges. But we do believe that they may result in higher cost of maintenance in later years as well as an earlier and lower posting for reduced load limits as deterioration takes place. One of the principal objections to "H" loadings is that they do not give a reasonably constant factor of safety for different spans.

An extensive study of some of these features has been made by Messrs. McCullough and Paxson of the Oregon State Highway Department. In Technical Bulletin No. 6, they conclude: "In view of the interstate character of a large percentage of the heavy motor transport operating over the nation's highway system today, it is highly desirable that the regulations as to limiting weights and dimensions of motor transport units adopted by the various states be uniform, particularly throughout any single trade area, such, for example, as the western states."

The treatment of bridge foundations has made reasonable progress. Frequently in the past the expense of extensive exploration was not justified for small structures, and bridge engineers were prone to hazard an educated guess as to supporting values of underlying materials. However, with present equipment and methods of soil investigation, the average bridge site can be explored at nominal cost, and designs can be prepared on the basis of actual findings.

During the past few years much research and investigation of the action of various soils under load have made possible a predetermination of subsequent action, thereby eliminating to a marked extent the worry of future movement of substructures, provisions for which can be incorporated in the designs. The electric seismograph has been used to a limited extent and promises to be of more use in the future.

CONSTRUCTION MATERIALS IMPROVED

Concrete is no longer a haphazard combination of cement, sand, and gravel or rock which "looks all right." It is a product of known values, accurately compounded to produce planned results. Aggregates are carefully selected, graded, and proportioned by weight. Cement and water are under full control to produce uniformity throughout the mass. As a result of more scientific control and the use of the mechanical vibrator, working stresses have been largely increased beyond the former 650 lb per sq in. At present 750 lb is about the minimum, but several states use 1,000 lb—in some instances Washington has used 1,200 lb.

Recent investigations have shown that the "wear and hardness test" for concrete aggregates is not indicative

FOUR TRAFFIC LANES PROVIDED IN STRUCTURE OVER SOUTHERN PACIFIC RAILROAD AT ALBANY, ORE.

Because of Sharp Skew Angle, Tracks Actually Pass Between Columns of Individual Bents, Entering Structure at One Span and Leaving from the Next. Bents Designed as Rigid Frames. Each Alternate Span Employs Suspended Girder Type of Superstructure with Toggle Joint to Support Suspended Member

of the true strength of the resulting mix. Several tests using softer aggregates show higher strengths caused by higher bond strength between the mortar and the aggregate.

Steel is one of the most consistent materials of construction, because of the control exercised during its manufacture. Many alloys have been developed in recent years to meet specific purposes, and these have made possible many notable structures.

Wide-flange 33-in. and 36-in. steel beams facilitate construction of short cantilever and suspended-beam superstructures. A pleasing type of continuous beam is obtained by severing part of the flange from the web, bending the flange to form a predetermined curve, and filling in the web with a welded plate. Increased moments of inertia are thus obtained at points of critical stress. Working stresses in both structural and reinforcing steel have been increased from 16,000 to 18,000 lb per sq in.

Silicon alloy steel having a working stress of 24,000 lb is quite commonly used. Within the last year California has specified a nickel copper alloy with an allowable working stress of 27,000 lb.

The more general adoption of the theory of limit design will result in even greater economies. This theory takes advantage of the ductile properties of steel and bases working stress upon the yield point instead of upon the arbitrary stresses now generally employed.

A more economical use for timber has resulted from the development of shear connectors and laminated members. One noteworthy improvement is the salt treatment for timbers, which permits painting of the treated surfaces for increased visibility and improved appearance. There has been little change in the allowable working stresses for timber; they still remain about where they were in 1920.

New structural types are gaining popularity. Mass or gravity abutments have generally been discarded in favor of reinforced concrete cantilever, or counterfort types. The multiple simple span structure is rapidly becoming a thing of the past; it is being supplanted by continuous slabs and beams. Statically indeterminate structures are becoming increasingly commonplace. Members with variable moments of inertia, such as rigid frames, are now an indispensable requisite of bridge design.

The use of standard designs has almost disappeared. More thought is being given to savings that can be effected in designing the structure for the actual site upon which it is to be built. More extensive preliminary investigations now reveal the economy of this kind of individual treatment.

APPEARANCE RECEIVES INCREASING EMPHASIS

In all these instances the application of engineering experience and ingenuity can result in countless additional economies and in the more useful employment of materials of construction. Mere utility is not sufficient today as in the past; present-day structures must be both safe and of good appearance. To this end bridge engineers have endeavored to arrange and modify the hard lines of structural members to secure pleasing shapes.

BRIDGE OVER SACRAMENTO AT RED BLUFF, CALIF.

Stiffener Angles on Plate Girders Suggested Motif for Effective Bridge Rail Treatment

Twenty years ago, and even more recently, economy of construction was the predominant thought, and resulted in many unsightly structures. But now a limited expenditure for improved architectural appearance is considered justifiable. At first this reaction resulted in the addition of gingerbread, filigree, and other appended decorations; more recently simple lines and plain surfaces in proper proportions have greatly improved the appearance of concrete structures with but little in-

TWIN STRUCTURES PROVIDE PLEASING TREATMENT OF UNDERPASSES AT DENVER AND RIO GRANDE WESTERN, AND UTAH RAILROADS NEAR SPRINGVILLE, UTAH crease in cost and without unduly disguising the main lines of the structure.

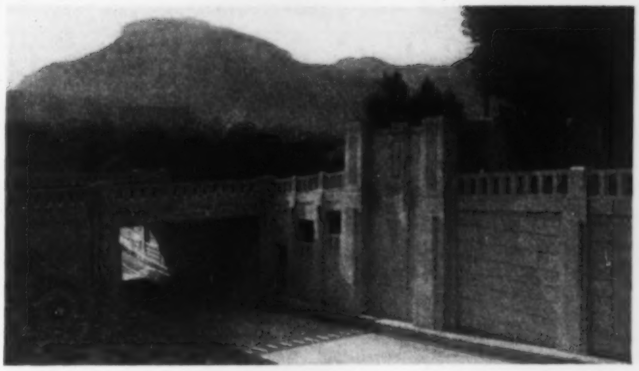
Two decades ago timber, often untreated, was commonly employed for truss and trestle structures. Now, however, the development of other materials, with lower construction and maintenance costs, has caused a noticeable decrease in the use of timber. Montana and Wyoming, owing to some special conditions there prevailing, still use it quite extensively for trestles. Other states have developed substitute concrete designs—California has a continuous slab on concrete piles, New Mexico a multiple concrete box.

The steel truss has its proper place. But the increase in the economic length of beam spans coupled with the increased cost of truss spans having wide roadways, suggests instead the use of continuous deck girders. These have the advantage of providing an open view and of being more adaptable to future widening.

Pleasing Arch and Abutment Treatment on Boise River Bridge near Boise, Idaho

Even as increased traffic conditions have demanded improved alinement for structures, they have also demanded increased widths for roadways. There has been a greater change in these standards than in any other phase of highway design. Twenty years ago the standard road width was 18 ft for two lanes of traffic. This was increased to 20 ft, then to 24, and now most states use 26 ft as a minimum for a two-lane structure. With the advent of the four-lane divided highway, the bridge roadway width has increased to 52 ft or more.

Pedestrian walks are also provided where warranted and these vary throughout the states from 3 ft upward.



Interesting Underpass Design Has Long Plain Surfaces Broken by Offsets and Grooves
Denver and Rio Grande Western Crossing at Helper, Utah

When sidewalks are not considered necessary, some states have provided wide curbs (usually about 18 in.), which may serve as a refuge for the occasional pedestrian.

DEVELOPMENTS CONTINUE IN MANY LINES

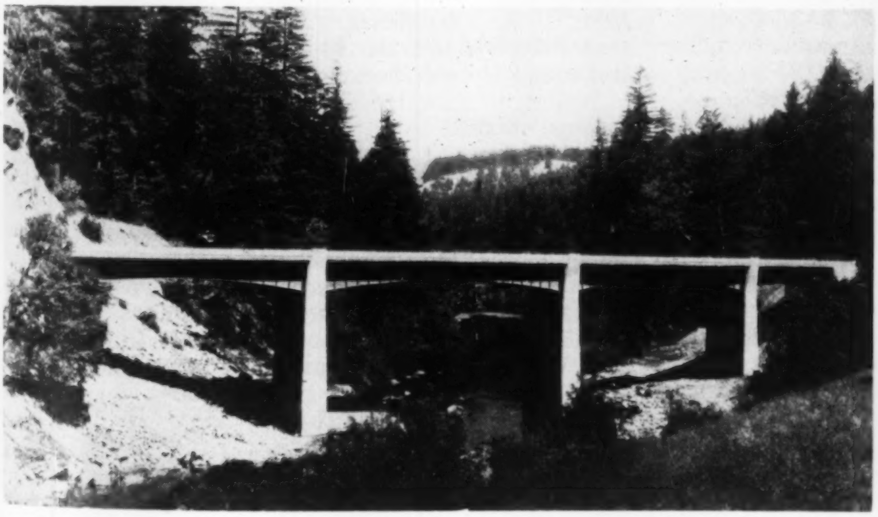
New types of construction equipment and improvements in old types have contributed their part to producing better structures. Excavating equipment handles larger quantities with more dependability. Pumps are less troublesome. Self-priming pumps provide better unwatering control. Hoisting and elevating equipment appears to have fewer breakdowns. Drill steel and small tools require fewer trips to the blacksmith shop. Concrete mixers really mix a uniform product. Appliances for forms provide better control against bulging and buckling. Plywood for concrete forms provides faster construction with less loss of mortar through joints. Mechanical vibrators facilitate compaction. Mechanical grinders produce better surfacing. Air-brush painting has its advantages.

Thus we might continue. But without skilled operating personnel, the ultimate result would be distressing. Were it not for the resourcefulness of the construction industry, its persistence and continued diligence in bringing to a reality the vision of the designer, we would indeed be as a schooner without a sail.

Bridge engineering is a most interesting vocation. It requires an intimate knowledge of many associated industries, arts, and crafts, together with the application of the principles of allied branches of engineering. It gives a field for individual expression through the use of ingenuity in combining theory and practice so that natural obstacles may be traversed with safety by a speed-conscious public.

Unrelenting study, analysis, investigation, and research on the part of individuals, institutes of learning, societies, and associations of engineers, manufacturers, and fabricators, have contributed and will continue to contribute more and more to the development of bridge engineering.

I acknowledge here the valuable suggestions and other assistance extended to me in the preparation of this paper by bridge engineers of the Public Roads Administration as well as by those of the western states.



Simplicity and Strength in Design Harmonize with Wilderness Setting
120-Ft Spans Bridge South Fork of Eel River, California

Athletic Fields at Colgate University

By Gavin Hadden
Member American Society of Civil Engineers
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Laying out an athletic field might appear at first thought a simple job of arrangement, grading, and drainage. Mr. Hadden shows how each of these features requires study and judgment to reach the well-rounded solution found for the work at Colgate University. Such problems are closely analogous to those involved in landing or flying fields, so that this paper actually has a value beyond its own immediate scope.

THE new athletic fields recently completed at Colgate University, Hamilton, N.Y., presented some interesting and rather unusual problems in design and construction. Since the fields are in the bottom lands along Chenango Creek, drainage was a very important consideration. It was necessary to adopt exceptionally flat slopes for surface drainage, and this in turn influenced materially the design of the entire drainage system and the construction procedure.

In total area the new fields comprise 32.7 acres. Considerable portions have been finished with a slope of 1 on 314 (about $^1/_{26}$ in. per ft), continuing uniformly for distances of as much as 400 to 600 ft. Elsewhere, in the more important playing areas such as the major football field and the infield of the major baseball diamond, the finished surfaces have more orthodox slopes, of 1 on 95 and steeper. The maximum slope on the diamond is about 1 on 70.

To produce the best playing conditions for the major football field, and also to provide properly for the future running track that will surround it, it was necessary to make the grades symmetrical about its two major axes, with a level loop all the way around the outside of the gridiron. Likewise, in order to produce the best playing conditions for the major baseball diamond, it was necessary to form an approximately symmetrical mound, with its apex close to the pitcher's box and its base outside the infield. These two important major playing fields are located in the higher areas of the site, thus still further improving their drainage conditions.

Referring to the plan showing the layout of the fields (Fig. 1), the drainage system, both surface and subsurface, involves:

1. Surface slopes leading to a loop drain surrounding the major football field.
2. Surface slopes leading to a loop drain surrounding the infield of the major baseball diamond.
3. Surface slopes leading to a drain and an open ditch at the downstream (south) edge of the field.
4. Surface slopes leading directly to a catch basin (*CB*1) near the creek, at the west side of the fields.

There is complete coordination between the surface drainage system and the subsurface drainage system, all the surface flow being discharged into the subsurface system or the ditch. For the most part the subsurface drains serve the two major fields only. The two loop drains that form the principal parts of this system were made necessary primarily by the special requirements of the two major fields. Except for the area served by the loop drains and that served by the special cutoff drain near the southeast corner of the field, surface drainage and catch basins only are relied upon.

It is to be noted that establishment of definite valleys for carrying surface water across playing areas was carefully avoided. Such valleys would be wet and unsuitable for play long after the rest of the area had dried out.

With the drainage system divided into the four areas enumerated, the main drains (which are outfall drains only and in no sense collecting drains) necessarily cross the ridges. It might seem that some advantage could perhaps have been gained by running the 12-in. line from the baseball diamond over to the ditch at the south side, instead of running it to the 24-in. line as shown. However, the difference in length would be only about 15 ft, an advantage more than counterbalanced by two considerations: A larger culvert would have been required for the ditch near the outlet; and in future, when probable extension of the fields to the south is carried out, the other arrangement would cause a material increase in the cost of substituting a pipe drain for the ditch.

The subsurface collecting drains are laid with the lower halves of the joints left open for the admission of ground water, and with trenches backfilled with gravel, following well-established practice. Wherever the drains underlie areas required for play, the gravel is covered at the surface with a specially prepared porous topsoil; elsewhere runoff is facilitated by carrying the gravel all the way to the surface.

The two loop drains discharge into 24-in. and 12-in. drains, respectively (Fig. 1), laid with completely tight joints. These join at a manhole (*MH*2) located clear of the playing fields; thence the flow is carried through the catch basin *CB*1 to the outlet as shown.

Because of the flatness of the slopes over the site as a whole, and low elevation of the fields above the creek, it was necessary to adopt not only exceptionally flat surface slopes but also unusually flat grades in drains, and correspondingly low velocities. As this tends to increase silting, the system provides manholes and catch basins at all necessary points (always clear of the playing fields) to permit rodding or flushing. Experience shows that silting is comparatively slight on an athletic field, once it is completed and is covered with a good growth of turf.

In designing the drains, runoffs were estimated by the rational method based on 2-hour storms of 5-year frequency. Kutter's formula, with n equal to 0.015, was used for determining sizes and slopes. The design of the fields provides for the construction in the future of permanent concrete seating decks for spectators at the major football and baseball fields; therefore provision was made in the drainage system for the higher runoffs that these decks will produce. Provision was also made for all necessary future connections to the drains.

A few of the controlling invert elevations are shown in Fig. 1. The following table gives the slopes and velocities of the various outfall drains:

Drain	Size	Slope	Velocity
*CB*4–*MH*2	12 in.	0.0015	1.4 ft per sec
*MH*16–*MH*7	18 in.	0.0009	1.5 ft per sec
*MH*7–*MH*2	24 in.	0.0011	2.0 ft per sec
*MH*2–*CB*1	24 in.	0.0015	2.4 ft per sec
*CB*1–Outlet	24 in.	0.003	3.4 ft per sec

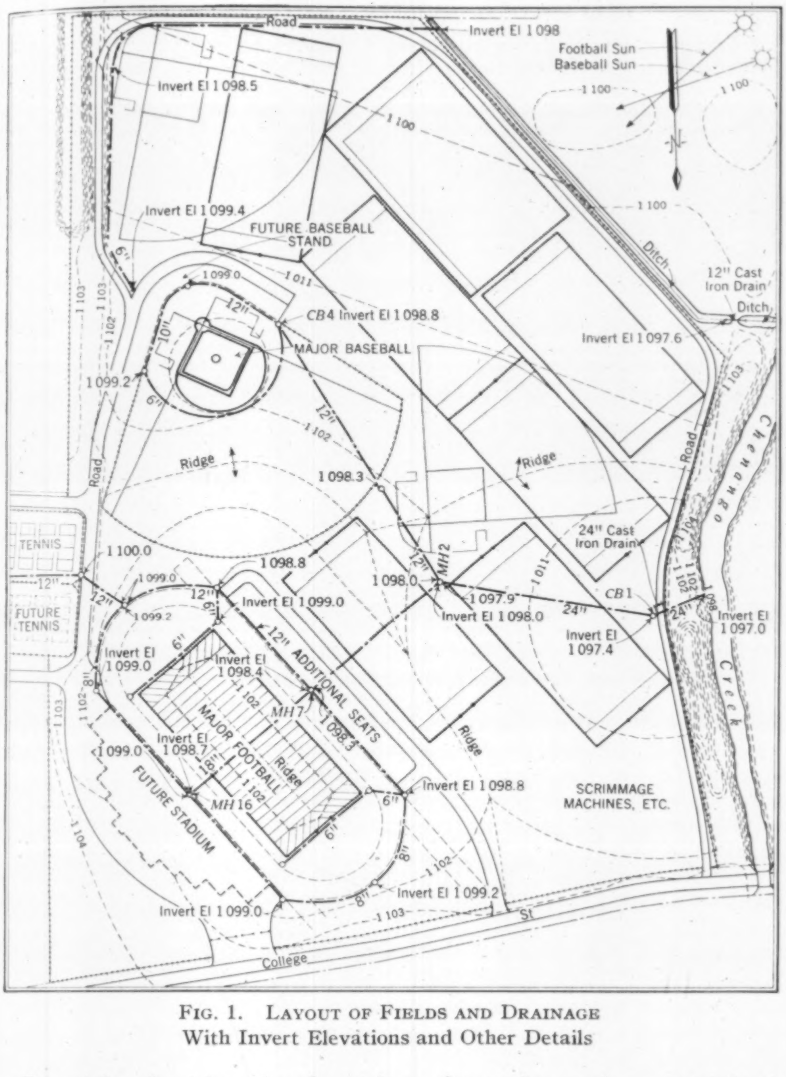

Road
Invert El 1 098
Football Sun
Baseball Sun
1 100
N
Invert El 1 098.5
Invert El 1 099.4
FUTURE BASEBALL STAND
Ditch
12" Cast Iron Drain
Ditch
6"
1 099.0
1 011
12"
CB4 Invert El 1 098.8
10"
MAJOR BASEBALL
Invert El 1 097.6
1 099.2
6"
1 103
1 102
12"
1 102
Ridge
1 098.3
Ridge
Road
Road
Chenango Creek
TENNIS
1 100.0
12"
FUTURE TENNIS
1 098.8
24" Cast Iron Drain
1 099.0
12"
1 099.2
12"
6"
Invert El 1 099.0
MH2
1 098.0
1 097.9
Invert El 1 098.0
24"
CB1
24"
Invert El 1 097.0
Invert El 1 097.4
1 104
Invert El 1 099.0
6"
Invert El 1 098.4
12" ADDITIONAL SEATS
8"
MH7
1 098.3
MAJOR FOOTBALL
Ridge
Ridge
Invert El 1 098.7
18"
1 099.0
MH16
FUTURE STADIUM
Invert El 1 098.8
6"
6"
SCRIMMAGE MACHINES, ETC.
8"
1 102
1 104
8"
Invert El 1 099.2
Invert El 1 099.0
1 103
St
College

Fig. 1. Layout of Fields and Drainage
With Invert Elevations and Other Details

Except for short lengths of cast-iron pipe under roads all the drains are of vitrified pipe with bell-and-spigot joints. In the vicinity of *CB*1 the large pipe is close to the surface, with a minimum cover, at the top of the bell, of only about 4 in. This cover is sufficient protection from the heaviest probable loads, such as tractors and grass cutters, used during maintenance. It did not suffice, however, to protect against the heavy earth-moving equipment used during construction; in spite of all efforts, a few lengths of vitrified pipe were broken in the course of the work and had to be replaced.

In designing this drainage system, careful provision was included for drainage on the surfaces of the subgrade as well as on the finished surfaces, excluding all underground drains whose usefulness could not be predicted with reasonable assurance beforehand. Subsequent additions have been negligible and the total cost of the work has been unusually low. The old idea that it is always necessary to install a grid of small drains under the surface of an athletic field was exploded long ago.

LOCATION OF PLAY AREAS INTERRELATED

On all the fields the areas required for play are defined with considerable exactness. It is of course advisable to locate obstructions on or above the surface so that they will not interfere with play. Such obstructions may include manholes, catch basins, open ditches, gravel surfaced ditches, hose outlet boxes, and drinking fountains, as well as more obvious features such as retaining walls, steep banks, seating decks, and fences. Obstructions caused by equipment for the games themselves, such as goal posts and backstops, are in a somewhat different category—their locations are fixed with respect to the fields they serve, and it is necessary to place them so that they will not interfere with other fields nearby; or, if the same areas are to be used at different times for different activities, movable equipment may be provided. For these reasons, and also for economy, efficiency, and prevention of waste, it is always the soundest practice to determine accurately beforehand the location of all playing fields.

The plan of the fields shows how intensively the entire area is used. Among the considerations that influenced the layout were the following:

1. Orientation of the field of play. For the major football and baseball fields the orientation is as close to the ideal as possible. In Fig. 1 the arrows marked "football sun" and "baseball sun" represent the average direction of the sun's rays during the football and baseball playing hours, respectively. The accompanying aerial photograph happens to have been taken at almost the exact instant of perfect orientation for the day, as the shadows of the goal posts and other vertical objects are almost exactly parallel with the end lines of the field.

Locating the future stadium on the east side of the field, where the majority of the spectators will face the afternoon sun, was the subject of very careful consideration by the University. Other conditions seemed to outweigh the disadvantage of glare in the eyes of the spectators—such conditions as (1) greater convenience of access for spectators and of blocking "deadhead" views of play, (2) improved economy of ground, (3) more pleasing appearance of the fields as a whole, (4) more sightly background outlook for the majority of the spectators, and (5) the fact that high hills to the west cut off the sun's rays long before sunset. In addition, many spectators prefer to sit on the sunny side of the field, where they are protected from prevailing autumn winds.

Similarly, the orientation for most of the other fields is ideal or nearly so, only one minor football field and one minor baseball diamond being much out of line. In a development of this size it may even be an advantage to have some fields with bad orientation so that the players can accustom themselves in practice to conditions they may have to meet in games elsewhere.

2. Location of major fields on the higher part of the site, and provision of suitable areas for future seating decks. This location makes these fields more readily accessible to both players and spectators. In the aerial view spectators are seated on temporary stands, as no part of the permanent seating decks has yet been built.

3. Avoidance of encroachment of any part of a field for football, soccer, or lacrosse, on any part of the infield of a baseball diamond. This permits the use of "skinned" diamonds without any heavy maintenance costs in shifting from one game in the spring to another in the fall.

4. Location of all baseball backstops and of all but one pair of the football goal posts so that they may remain

permanently in place. The one pair of football goal posts that must be moved to avoid interference with an auxiliary baseball field is common to two football fields whose end lines coincide. This close juxtaposition is entirely satisfactory for simultaneous practice or informal play, and the common pair of posts avoids the confusion that may result if two separate pairs of posts are set close together.

No parking space for the general public is included in areas devoted to athletic fields themselves, but ample space for this purpose is provided nearby. A comparatively small number of cars can be accommodated inside fence lines, but every effort is used to keep the number to a minimum; numerous cars entering the fenced enclosure shortly before the beginning of a game may cause serious annoyance, delay, and interference with spectators on foot.

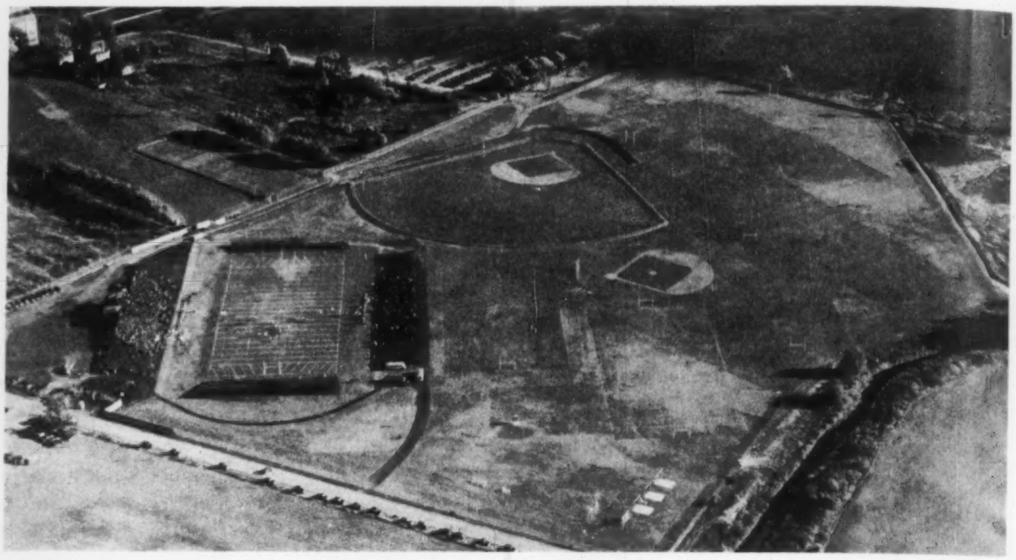
Also, it is usually considered economically unsound to allow auxiliary playing fields to be used for parking. The wear and tear may be ruinous to the turf, especially because football games are played on schedule even during extremely wet weather.

The fact that the surface of the bottom lands was originally nearly level constituted an advantage in that the amount of grading work required was comparatively small and all the cuts and fills were relatively shallow. It was possible to do the rough grading very economically with a large automatic grader. The same machine was used for stripping and rough spreading of topsoil; it was, however, not capable of producing the fine results required for the accurate final surfacing, which was therefore carried out principally by hand. Great care was used, in composting and in selecting suitable seed, to insure a strong and uniform growth of grass, so important for a satisfactory athletic field.

LOOP CONNECTIONS FOR WATER

A useful adjunct, frequently of vital importance, is an adequate water supply system. Water is useful for sprinkling the fields to prevent the grass from being burned up during dry spells, for drinking by players and spectators, and for other incidental purposes. The system for the Colgate fields (omitted from Fig. 1 to avoid confusion) consists principally of a loop supply encircling the football arena; a loop supply encircling substantially the entire baseball field, both infield and outfield; a loop connection between these two loops; and various branch supplies extending to outlying parts of the area. Hose outlets, connecting with these supplies, are located out of the way and underground, in boxes with flush wood covers; every part of the turf can be reached by hoses not more than 200 ft long; the entire varsity football field with hoses not more than 125 ft long; and the infield of the varsity diamond with hoses not more than 150 ft. long.

The pressure at the meter was estimated as 95 lb, and the system is designed to permit simultaneous operation of at least four sprinklers, each at the end of a 1-in. hose 200 ft long, with a minimum of 20 lb of pressure at the sprinklers.



AERIAL VIEW TAKEN DURING FOOTBALL GAME ON MAJOR VARSITY FIELD
Note Desirable Orientation for Autumn Sunlight

As an indication of the low cost of the grading work, the following quantities and contract unit prices for some of the more important items may be of interest:

ITEM	QUANTITY	UNIT PRICE
Topsoil stripping	33,450 cu yd	$0.27
Subsoil cut and fill	13,400 cu yd	0.25
Topsoil spreading and compacting	25,800 cu yd	0.30

The difference between the first and last quantities indicates a shrinkage of about 23% in the topsoil during handling. Such figures have rarely been published. The low cost of the water supply system is indicated by the unit contract price for laying the 2-in. pipe—the size used in most of the system—which was, including all ditching and backfilling, $0.65 per lin ft for 3,442 lin ft.

FLOOD REGULATION IMPORTANT

In the design of all engineering works involving drainage systems, and particularly those located near natural water courses, flood control and flood damage must be considered. Athletic fields such as those at Colgate University are used only intermittently—during comparatively few hours and comparatively short seasons—so that floods occurring at other seasons, even if fairly frequent, may in themselves not cause interruptions. These bottom lands were originally subjected to such frequent and continuous flooding from Chenango Creek that they were all but useless for athletic purposes. Regulation works have now brought the floods under reasonable control, and although freedom from all damage and interruptions is by no means completely assured, especially on the lower parts of the area, the chances of serious trouble of this sort have been reduced sufficiently to justify the construction here described.

The general contractor, who did the grading, drainage, and water supply work, was G. W. Hinman of Madison, N.Y. The project was in general charge of William A. Reid, Director of Athletics of Colgate University, who directed the final surfacing and seeding, carried out by force account. The writer was in charge of design and general supervision of construction.

The Engineer and the Law

FROM A PAPER PRESENTED BEFORE THE MICHIGAN SECTION OF THE SOCIETY

By W. C. SADLER

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

ATTORNEY AT LAW; ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICH.

THAT the complicated body of present-day law has any basis in "sweet reasonableness" is a fact sometimes doubted by men with scientific training. Engineers well know the inconsistencies caused by blind attempts to adjust obsolete precedents to fit the vicissitudes of mechanized living. Mr. Sadler, however, shows that an underlying social philosophy dictates most legal decisions, even though they may at first seem obscure. With illuminating examples from subjects as widely different as the neighbor's apple tree and the jurisdiction of labor cases on navigable river construction, he indicates how engineers could profit by a fuller knowledge of law.

HISTORICALLY, the rules of society started out in very simple form, and were founded on the doctrine of self-help, under which the aggrieved party personally could redress the wrong in a prescribed manner. For example, the creditor could personally retain the body of the debtor in satisfaction of a debt. As the state recognized an increasing interest in the rules of society, such customs gave way to written laws. From tribal days down to the present there has been a gradual evolution to meet the demands of the times. And as the engineer, with his contrivances, has contributed to make life more complex, he has a vital interest in law, which has grown and expanded until today we have the most intricate legal system in history.

Now because of its many ramifications it might seem at first blush that the law as a whole is incomprehensible. Such is not the case. The law is but man-made rules with particular provisions designed individually to accomplish objectives, but in the aggregate founded upon a common philosophy of the public good. An understanding of this philosophy makes the entire subject seem simple and logical. It is difficult to start in a more fundamental, or a more intimate manner, than by examining our relations with our neighbors—the "law of the back fence." I have an apple tree in my yard, but it is so near the fence that branches hang over your yard. According to a Latin doctrine, as freely translated, "To whomsoever the soil belongs, he owns also to the sky and the depths." In short, you own from the center of the earth to the top of the sky, and the branches of my apple tree are in the space over your property. You have a remedy. You can cut the overhanging branches, and you can also recover money damages, for the injury, if any, to your property. If my bull jumps the fence and injures your garden, surely you could not keep the animal as a remedy; though you could get money compensation for the damage. Neither could you keep my branches which you cut off, nor my apples on your side of the fence. It was a trespass for my apple branches to occupy the air space above your ground.

This principle has had important applications in the field of mining, where underground workings find their way across property lines. The man on the surface owns to the center of the earth.

As applied to percolating water and to oil wells it offers some difficulty. Generally a property owner may use as much of the subsurface percolating water as is necessary to the enjoyment of his land. He may carry on pumping operations even though the water table is lowered to the detriment of his neighbors. These property rights are materially changed, however, where the pumping processes are for water uses beyond the limits of the land. City-owned artesian wells, where the water is pumped from the country to the city, will make the city liable for injuries incident to this operation. Damage suits may run easily over three dollars per capita, and should be anticipated by the water works engineers.

In the case of oil wells, the oil is pumped by all property owners, for distant markets—probably the fundamental difference between this case and the case of percolating waters. Since it is impractical to trace where the oil comes from, any property owner may drill as many wells as he chooses, and pump as much as he likes. However, excessive pumping of oil might readily lead to ruining of oil pools, through salt influx, and also to the wasteful depletion of natural resources. For these reasons it is highly desirable that the state exercise its police power to the general interest of the commonwealth. This usually takes the form of oil and natural-gas regulations of a state department of conservation and forestry, or some such administrative tribunal.

Of recent years, the matter of property rights in air spaces has become of particular importance to civil aeronautics. The courts have approved legislation toward the regulation of air traffic as an inherent part of the sovereign power of the state. In the recent case of Smith vs. New England Aircraft Company, controversy arose because planes duly licensed under the Massachusetts law were flying over Smith's fine private estate outside of Boston. He sought an injunction to restrain them, not on the basis of injury to his land or negligent flying, but because there was a trespass in his air spaces. The court denied the injunction, and it could not do otherwise if we are to have aeronautical service. The court was very careful, however, to limit its decision. If the planes were dangerous, dropped articles, ruined crops, caused a noise, smoke and general nuisance, Smith could

SEWERS LIKE THIS AFFECT PROPERTY VALUES
"Nuisance" Conditions Subject of Potential Legal Action

have received his injunction. Modern law, flexible as it is, had no difficulty in adjusting its doctrines to keep pace with the engineer's airplane. It is properly within the police power to keep planes, 1,500 ft above a football stadium.

Now consider for a minute the situation where there is an actual conflict between these property interests of the land owner and the aeronaut. In about 1822, Guille settled his balloon onto Swan's garden, injuring the vegetables to the extent of $15. He was liable for this injury. But the falling balloon attracted a crowd of men and boys, and in their excitement they trampled the rest of the garden causing an additional damage of $75. The issue was then raised whether the balloonist would have to pay not only the original $15 but also the additional $75. The court turned for a precedent to an early English case in which the party who started the mischief was held responsible for all the ensuing damage. Hence Guille was held responsible for all the resulting injuries to Swan's garden. It should be noted that it was not necessary to show that Guille negligently operated his balloon, or even that he invited the crowd. There was a conflict of property rights, and the balloonist was guilty of trespass.

FISH KILLED BY GARBAGE REDUCTION WASTES
Results of a Poorly Designed Settling Pond at French Landing on the Huron River

In a more recent case, also in New York state, transmission towers of the Rochester Gas and Electric Company were hit by a low-flying airplane, and recovery was granted for the injury sustained by the steel towers. This case did not turn upon negligence of the pilot, but rather upon damage resulting from an actionable trespass.

Now if a party decides to erect a two-hundred-foot radio tower on his property, he must secure a license from federal authorities. One condition of the license may be that the tower be properly lighted. There is a serious question, however, whether state or federal authorities legally can require lights on a tall chimney or a very high building on private property. In the case of the 6,241.5-ft cable span across a navigable arm of Puget Sound, the span was authorized by license from the United States and proper night lighting was a condition of the license.

Incidentally, we might examine the law on the subject of nuisance. A nuisance is defined as an annoyance. The operation of industrial plants is often a nuisance to nearby residents and this situation may give rise to lawsuits. It would seem, however, that all circumstances in the situation should be considered before remedies are ordered. For instance, in a rather recent case Anonia Bove brought an action against the Conner-Hanna Coke Corporation of Pittsburgh, for the noise, smoke, dust, dirt, noxious gases, and disagreeable odors from the defendant's plant. The city was zoned, the coke plant being in the zone permitting stock and other enterprises. At the time she entered this neighborhood there were twenty million dollars invested in industries and many workmen employed in the immediate area. There was no question as to whether there was a nuisance; the issue turned on whether under the circumstances relief should be granted. The court simply refused to order an abatement of the nuisance, calling attention to the fact that the plaintiff knew the situation at the time she entered the area.

Another situation in the same category arose in the Pennsylvania coal fields. The waste material from a mine is customarily piled in a big heap called a culm pile. Wind whipping across such a pile frequently raises a heavy cloud of dust. Relief was denied because the plaintiff had suffered the Collieries Company to deposit mine waste on this pile for a period of eight years. The plaintiff himself was guilty of laches in not prosecuting the case earlier. We have the same situation where the fumes from a copper smelter annoy a rancher. He permitted the plant to be built and operated for years before he raised his complaint. By that time two million dollars were invested in the plant and ten thousand people employed in the factory. He was dilatory in starting an action and an injunction was denied.

The type of relief utilized by the courts will vary according to circumstances. They sometimes forbid "excessive" or "negligent" operation as a warning that the company must cooperate in reducing an unnecessary nuisance.

Industrial operations frequently are jeopardized through conflicts with property interests in other directions, as where one factory interferes with the operation of another. The turning of condenser water into a stream may raise the temperature in the summer time so much that a factory downstream is unable to use the river water for condensing purposes. Now there is a fundamental law subject to a few limitations, in the matter of riparian rights that a person is entitled to the flow of the stream past his property undiminished in quality or quantity. It has been somewhat universally held from early industrial times down to the present that the raising of temperature of river water is an abuse of this rule and must be abated accordingly. Incidentally there are some interesting cases in which ice companies have brought successful action against an upper riparian owner for turning heated water into a stream.

Another problem concerns the pollution of streams by industrial waste. The old doctrine that water must continue to flow in the stream undiminished in quality may be modified to permit normal manufacturing activity. In washing raw materials in connection with the bleaching of cloth, fine short threads are deposited in the water. As a result the bleaching operations of lower riparian owners are seriously impaired. While it may be impractical to abate the nuisance 100%, regulations usually require the use of settling basins, screens, or other devices to minimize it. These problems also arise in the depositing of waste dye matters and acids in the water.

State authority may be used through the police power to protect fish life. Public health also can be used as a basis against the depositing of sewage. From these sketchy remarks it is quite evident that each designing engineer should have a full understanding of the law in his own state regarding the use of water and so lay out his plant that the operation may be conducted in a legal manner, and not be subjected, later on, to expensive alterations.

Zoning ordinances are very seldom instituted with the founding of a city, but are rather afterthoughts devised to direct the trend of future growth. It is a fundamental law that a person has the right to use his property as he chooses provided he does not intrude upon the rights of others. With the introduction of a zoning ordinance, it is therefore necessary to accept the conditions in the city as they then exist and to insert a "non-conforming" clause in the ordinance. By this provision, an existing factory may continue to operate in a zoned area provided such operation is reasonable and does not interfere with the public health and safety. If this factory is abandoned for a designated period, or the buildings burn down, the zoning ordinance can then refuse to permit reopening of a manufacturing plant on that property. This is the normal procedure for handling non-conforming uses in a restricted area. Zoning restrictions are justified under the police power, and all the regulations must find some real foundation in that source of authority. For instance, provisions restricting the distance of buildings from the property lines are justified on the basis of public health and safety through fire protection. The height of buildings may also be regulated on the same basis. The specification of certain building materials, as commonly provided in building codes, has its legal justification on the same grounds.

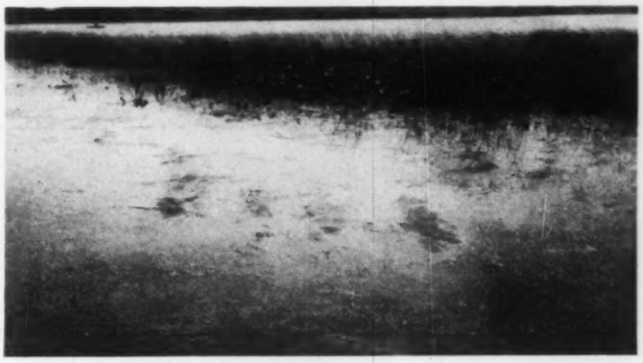
It should be noted that esthetic considerations are not proper grounds for zoning regulations. What might be very pleasing to some people might be highly discordant and distasteful to the community at large. In preparing zoning provisions extreme care must be employed to avoid those regulations which will absolutely eliminate any use of property. Consider for a minute a tract of land in an industrial area with railroads along two sides and a river on the third side. If this were restricted to Class A residential property, it could never be used because nobody would care to develop it for that purpose. Under such extreme circumstances, the zoning ordinance would be inapplicable to that tract as a taking of property without due process of law. It might be noted that a zoning ordinance should provide a board of zoning appeals as a buffer between the public and the legislative body of the community, so that the merits of peculiar grievances may be first considered by specialists and acted upon accordingly.

LIENS EVOLVE WITH INDUSTRIAL CHANGES

As mentioned previously, an aggrieved individual was originally authorized to seek his remedy through his own efforts. The common law lien is of this nature. The wheelwright repairs a wagon and he has the privilege to retain possession until the repair bill is paid. He cannot sell the wagon for the unpaid bill, and if he permits the owner to take the wagon away, the common law lien is gone forever. This would protect the creditor in his improvement of personal property, since he has possession of the same. But the common law lien is not applicable where a generator has been delivered to a power house, or a heating and ventilating system installed in an apartment hotel. In neither of these cases has the seller possession of the goods.

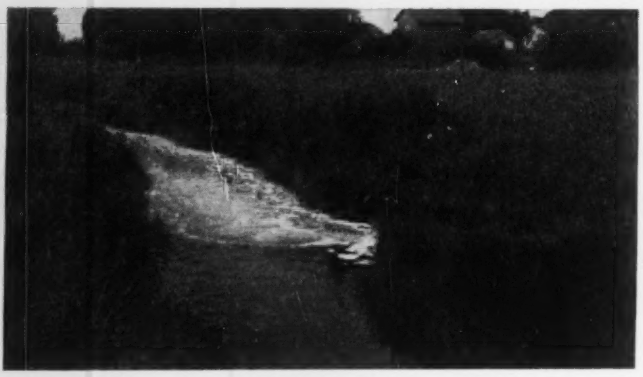
Mechanic's liens were therefore devised, whereby the creditor could place a lien for labor or material furnished for the improvement of property. While the statutes vary in the several states, they usually require notice to the owner of unpaid bills and a warning of a lien, the filing of the lien in the office of the county recorder, and ultimately the foreclosure of the property. It seems evident that material men, contractors, engineers, and architects as well as manufacturers of equipment, and even the owner himself should understand the mechanic's lien statutes in their states.

Admiralty jurisdiction was originally concerned with shipping on the high seas, and was designed to control ocean commerce, wrecks, salvage, seamen's problems, and the like. Since admiralty dealt only with the high seas, it was properly a federal matter. With the development of harbors and docks, and the start of water terminals, new questions arose. It became necessary to distinguish between state and admiralty jurisdiction. Consider one branch of the law—contracts, for instance. If the subject matter of the contract were maritime, as seamen's wages or marine insurance, litigation should be conducted in admiralty courts. However, consider a contract for the building of a ship. The work has been done on land, and the structure is not a ship until it is launched. The state should have jurisdiction. A man injured unloading a ship is in maritime work, because he is preparing the ship to return to sea; so also is a carpenter repairing a ship in dry dock, though the ship is drawn up on shore at the time. The building of a bridge across a navigable river is a state matter, although the federal statutes provide army approval of clearances and waterway openings. But if the contractor provides ferry service to detour traffic around the bridge during construction, it is subject to admiralty jurisdiction. If power lines are stretched over navigable streams, or cables laid along the river bed, they are not maritime problems and remain under state jurisdiction. A barge loaded with steel girders is a vessel, and therefore subject to admiralty jurisdiction.



Scum from Creamery Waste Discourages Swimmers at Popular Resort Lake

Lateral support has been the subject of some litigation in Michigan, and in fact has always been a matter of considerable concern to civil engineers working in metropolitan areas. Under the old common law a property owner could do about as he chose with his land, so long as he did not create a nuisance, or jeopardize the public health, safety, and welfare. If he should excavate along the edge of his land, however, he had to so conduct his operations as not to jeopardize his neighbor's land. The neighbor was entitled to his land in its natural position, and adjacent excavations should not be so conducted as to cause a cave-in. But it should be noted that the common law referred only to the ground in its natural state. If the neighbor had a building on his property which developed such a superimposed load as to be the cause of the cave-in, the owner of the building had no recovery. The erection of skyscrapers in large cities and the construction of subways have necessitated some radical departures from the old common law. Michigan, as well as many other states, now places the burden on the excavator. He must virtually do his work at his own peril. And it should be noted that successful litigation might be conducted for an instance where caisson pressures are too high, as well as where they are too low. In other words, where the old common law would grant recovery for injury to a building due to negligent operations, on the basis of negligence, some modern statutes provide specifically that the excavator has the duty not to injure another's building. In such cases it is no longer necessary to establish the negligence of the excavator. It is sufficient, legally, to connect the damage with the excavation, as the cause.


WATER COURSE CONTAMINATED BY MILK WASTES

An easement is a right of use in the land of another, and is usually evidenced by a deed. It is an interest in land. Easements are of some interest to engineers. The right of way for a transmission line, a railroad, or a street may be obtained for that particular use. Generally, this will result in a concurrent use, as where cattle in the meadow continue to graze, while the high voltage lines run overhead. In the case of a country highway, existing because of an easement, the abutting farmer as the owner of the servient estate can graze his stock on the grass between the road and the right-of-way fence. Incidentally, if there are apple or nut trees in the road area, the fruit belongs to the farmer. However, it has usually been held that the unused areas between the right-of-way fence lines of a railroad cannot be used by the farmer, because of the inherent danger from trains. It should be noted that oil or minerals below the surface would belong to the owner of the servient estate, such as the abutting farmer. The case where the Southern Pacific found oil under its property and was able legally to use the oil for railroad fuel is somewhat in point. Similar situations arise where easements are obtained for floodways or water-power reservoirs. Easements in metropolitan areas may be obtained for courts to provide light and air, or for common driveways or private alleys.

Easements are granted for a particular use, and this use cannot be changed except on mutual agreement of the parties in interest.

Consider the situation where a railroad enters a city on easements reading, "The grantee railroad may use this property for railroad purposes." Now suppose that over a period of years the city grows, and it becomes economically desirable to improve the railroad property with sky-right developments. This is the type of metropolitan construction where tall buildings are erected above the railroad, the trains running through the basements. The Grand Central in New York City and the Canal Street development in Chicago are illustrations. Now where the property rights for the railroad are based upon an easement for railroad purposes, a serious question arises whether the buildings overhead may be termed railroad purposes. If not, the air rights would revert to the original grantors, or servient owners. Long-term leases may avoid some of the difficulty. There are probably many old railroad terminals still in use with merely easement rights.

Party walls are treated in the United States as easements, each party owning his half thickness of the wall, and having an easement of support in the other half. In drawing up party-wall agreements, it is important to incorporate provisions for future contingencies, such as fires, earthquakes, or even the reconstruction of one of the buildings.

ARBITRATION CLAUSES SHOULD BE EXPLICIT

Engineering contracts frequently include provisions for arbitration to adjust future controversies. Arbitration and award were recognized in the old common law, although there are modern statutes in some states. In the simplest form of contract the parties merely submit the controversy to arbitration and agree to be bound by the decision of the board. The contract is the heart of the entire matter, and must be voluntarily entered into; for it would be illegal to coerce a party to substitute arbitration for his rights in a court of law.

The contract should be very clear as to the details to be decided, for the board cannot extend its jurisdiction beyond these instructions. The procedure before the board need not be formal, like a court of law. However, great care should be exercised to insure that each party in interest is given a full opportunity to hear and to be heard. The function of the board is not ministerial, but rather quasi-judicial since the arbitrators have full rights to use their discretion and judgment in the award. It should be noted, in particular, that while each party nominates an arbitrator, that arbitrator is not to be a representative or advocate of his nominator. Rather, he adopts the character of an impartial judge. This applies in particular to a chief engineer or architect appointed by specifications to arbitrate between his client and the contractor.

An award is the decision of the board of arbitration, and, generally speaking, either party may withdraw his participation prior to the announcement of the award; he is then liable only for those damages due to his breach of the contract.

The technical procedure varies with the common law and the provisions in the various state statutes. The matter may be presented to a court, together with the names of the arbitrators, and the court may order the arbitration. Eventually the decision of the arbitrators is brought back to the court for an order of execution. It is sometimes provided that the arbitrators can immediately start their hearings without any reference to the court, later bringing their decision into the court for a writ of execution. It is even provided that the arbitrators may record their award with the county clerk, which is a basis for a writ of execution.

In some ways the decision of a board of arbitration is final, like the verdict of a jury. The court cannot question the judgment or discretion of the arbitrators, for otherwise their work would be wasted, and a new trial would be started on the entire controversy. Of course the award is subject to legal attack on the basis of fraud, deceit, conspiracy, or practices contrary to law and public policy.

Engineers of today who fail to have an appreciation of, or an interest in, the legal significance of their activities are definitely limiting the possibilities of their service to the public and to their profession. To speak bluntly, they are also "missing a bet" in the matter of monetary compensation.

Distinctive Features of Grand Coulee Outlets

Model Tests Disclose Unexpected Low-Pressure and Spray Problems and Lead to Modifications in Conduit Profiles as Well as in Exit and Entrance Details

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Member American Society of Civil Engineers
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With great advances in the size and design of engineering structures, engineers are finding the model laboratory increasingly useful. The laboratory fills a unique need in supplying to a large extent the only substitute for precedents that do not exist. In this paper, originally presented before the Hydraulics Division at the Society's Denver Convention, Mr. Warnock presents concretely the story of the successive surprises encountered in developing outlets for one of the world's greatest dams.

With the development of larger structures, the increased head and larger quantities of water involved have made the problems of outlet design more complex. In the case of one large dam already constructed, an outlet through the spillway developed an excessive seepage leak near the upstream end after operating only a few weeks. Improper shape and position of the entrance had caused severe cavitation and the loss of considerable material in the roof of the conduits. In another case, the spray from the outlets was so excessive as to forbid release of water except in cases of extreme necessity.

In preparing for the Grand Coulee outlets, how were these known faults to be corrected? How were other errors in assumption or design to be avoided? Precedent could be of no assistance. The only expedient remaining was the use of models for a step-by-step design.

At Grand Coulee Dam, sixty 8-ft 6-in. outlets in tiers of 20 each have been provided to release 225,000 cu ft per sec. On preliminary drawings, Fig. 1 (*a*), the outlets were rectangular in cross section (5 ft 8 in. wide by 10 ft 6 in. high), longitudinal in plan, horizontal in section, and unlined. One tier of 20 outlets was at approximately El. 935.00 and the other tier of 20 at El. 1,110.00.

Severe splash and erosion were found to result from this design when it was tested in a 1:120 model representing the complete ultimate development. The jets from the lower tier impinged on the water surface downstream from the spillway bucket, and the upper tier produced practically the same result except that the scour in the river was even more severe. The destructive conditions were extreme, particularly along the riprapped banks of the power-house tailraces, and as a result of this undesirable situation the outlets with horizontal inverts were abandoned.

The outlets were next changed from rectangular to circular in cross section and placed on parabolic paths through the dam (see Fig. 1, *b*) so that the jets would plunge into the spillway stilling pool. The invert of the lower conduits was placed tangent to the spillway bucket, and pairs of outlets were made to diverge in plan to improve the energy dissipation. This became the final design of the lower tier at Grand Coulee except for a later entrance refinement to prevent sub-atmospheric pressures.

While the early studies were in progress, reports came from the Madden Dam on the Chagres River in the Panama Canal Zone, that a portion of the conduit roof in the outlets immediately downstream from the entrance had been destroyed after only a few weeks' operation. Apparently sub-atmospheric pressures and cavitation were produced by an incorrect shape of entrance and by a position of the conduit at an elevation too near the floor of the reservoir.

To avoid a repetition of these conditions at Grand Coulee, a series of entrance investigations was instituted. A cylindrical pressure tank (Fig. 2) 3 ft in diameter and 5 ft long was constructed with concentric distributing cones and a stilling rack to produce approach conditions similar to those in the prototype. A sharp-edged orifice was placed at the downstream end of the tank, and a detailed survey of the jet from this orifice was made with a specially designed instrument. The slope of the upstream face of the dam and the position of the control gates for the outlets had been established previously. With these limitations, and with the surveyed shape of the free jet, a bell-mouthed entrance with a converging elbow was developed. A model was installed in the pressure tank in place of the orifice, and detailed pressure measurements showed that the pressures throughout the

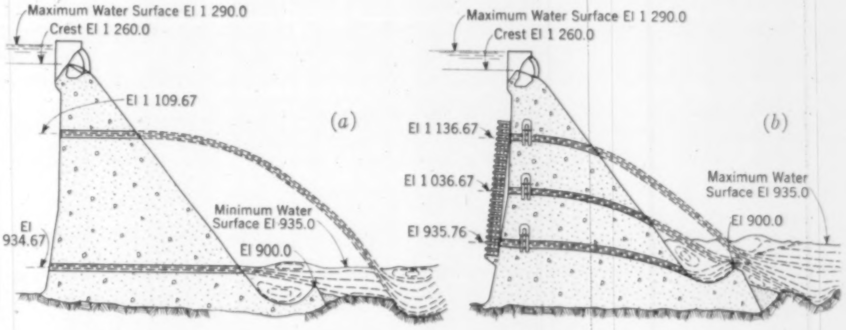
Maximum Water Surface El 1 290.0
Crest El 1 260.0
El 1 109.67
(a)
El 934.67
Minimum Water Surface El 935.0
El 900.0
Maximum Water Surface El 1 290.0
Crest El 1 260.0
El 1 136.67
El 1 036.67
El 935.76
(b)
Maximum Water Surface El 935.0
El 900.0

Fig. I. Early Designs for Grand Coulee Outlets
(*a*) Straight Discharge Caused Prohibitive Disturbances Downstream from Bucket
(*b*) Parabolic Profiles Also Missed Bucket, Produced Cavitating Pressures in Conduits

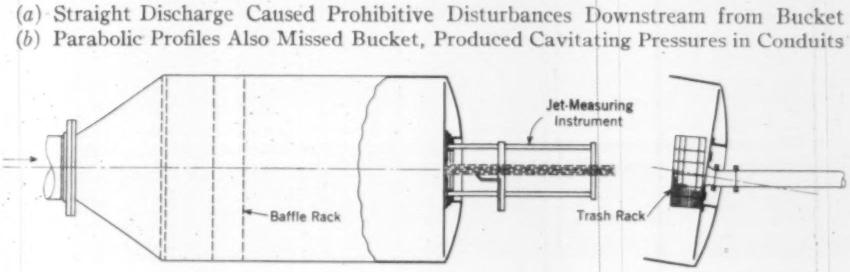

Fig 2. Pressure Tank for Study of Jet and Entrances
Trash Rack for Test of Entrances Designed from Modification of Free Jet Profile

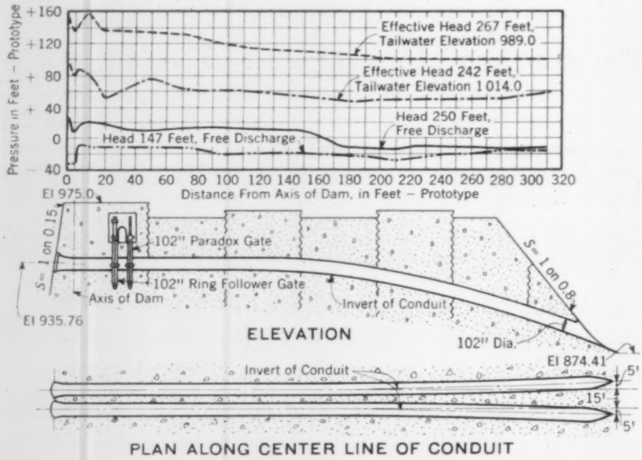
Pressure in Feet – Prototype
+160
+120
+ 80
+ 40
0
– 40
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
Distance From Axis of Dam, in Feet – Prototype
Effective Head 267 Feet, Tailwater Elevation 989.0
Effective Head 242 Feet, Tailwater Elevation 1 014.0
Head 250 Feet, Free Discharge
Head 147 Feet, Free Discharge
El 975.0
S= 1 on 0.15
102" Paradox Gate
102" Ring Follower Gate
Axis of Dam
El 935.76
Invert of Conduit
S= 1 on 0.8
102" Dia.
El 874.41
ELEVATION
Invert of Conduit
5'
15'
5'
PLAN ALONG CENTER LINE OF CONDUIT

FIG. 3. PRESSURES IN LOWER TIER OF OUTLETS
Conduit Discharges Directly Into Spillway Bucket, Normally Submerged

bell mouth and converging section were above atmospheric.

Since the trashrack structure might affect the entrance pressures, particularly for the lower outlet because of its proximity to the base, a replica was installed in the hydraulic model as indicated in Fig. 2. The tests revealed that the position of the bottom of the trashrack had the most influence while the effect of rib placement was negligible. A decrease in pressure along the top of the entrance resulted when the bottom of the trashrack was moved toward the opening. A position was finally chosen that gave positive pressures in the entrance and a velocity distribution such that no trouble should occur downstream.

"DOWN-PULL" ON GATES ELIMINATED

The acquisition of high-pressure pumping equipment for the study of the outlet entrance for the first time permitted a laboratory investigation of control gates. In the initial tests, made on a model of the Norris Dam penstock inlet tractor gates, the presence of a greatly augmented downward force was noticed when the gate leaf approached the closed position or during the first part of the opening cycle.

The control gates for the lower outlets at Grand Coulee are of two types. The upstream or emergency control is a ring-follower gate operated by a hydraulic piston. The downstream or service control is a paradox roller gate operated by motor and gear train connected to the gate stems. The gate leaves in the two types are fundamentally alike in that each has at the bottom a follower ring which comes into position when the gate is fully open, making the conduit an unbroken passage through the gate section.

In operating the model gate it was found that the force required to lift it at small openings was greatly in excess of the dead weight of the gate. When reversed in position, with the normally upstream face turned downstream, the gate leaf floated and required a downward force to close it. Analysis of the pressure data showed that as the gate leaf normally descended toward the closed position, its top was subjected to full reservoir pressure over its projected area. At the same time, the high-velocity jet passing through the constricted area between the partially closed leaf and the oppositely curved lower surface of the conduit produced a negative pressure over an area essentially equivalent to that subjected to full static pressure above. These two pressures produce a downward force upon the leaf and stem which has become known as "down-pull." Hydraulic balance was reestablished to a large degree by providing a vertical intercommunicating passageway behind the leaf in the gate bonnet and frame. This allows the excess pressure above the leaf to escape into the top of the conduit downstream from the gate and alleviates a condition which in the operation of the prototype would have been the source of much grief.

As yet no studies had been made of the performance of the conduit between the entrance and the exit. A pipe of the correct inside diameter and formed to the proper profile for the lower outlet was installed on the 1:17 model of the entrance and control gates. The pressure gradients throughout the conduit with the correct tailwater were above atmospheric pressure, as had been expected (Fig. 3). However, when the model was operated without the tailwater to simulate conditions in either of the upper tiers, the results were startling. Sub-atmospheric pressures prevailed in the model which, when converted to the prototype, would have caused absolute zero pressure through a considerable length of the conduit. Severe cavitation would have occurred in the prototype, hampering or even completely preventing successful operation. The fact that the frictional losses in the conduit were insufficient to overcome the accelerating force introduced by the slope of the conduit had apparently been overlooked.

Another condition that required further study was the formation of spray on the face of the dam. The canyon-wall outlets at Boulder Dam had demonstrated that the friction of the jet with the surrounding air created a dense spray which was carried up the canyon toward the power house, causing undesirable conditions and some actual damage to the power house doors.

The subsequent redesign of the conduits for the middle and upper tiers at Grand Coulee was therefore based on three objectives: (1) prevention of sub-atmospheric

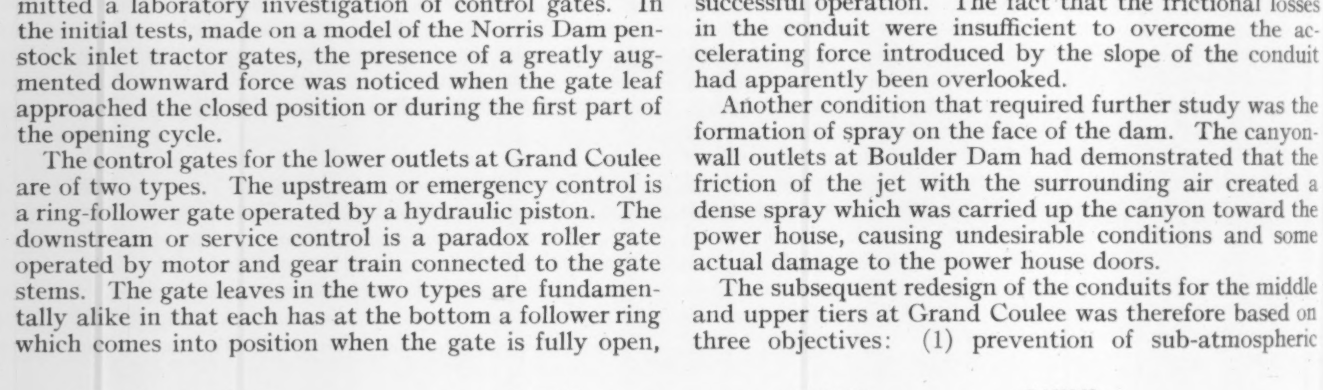
Maximum Water Surface El 1 290.0
Crest El 1 260.0
(a)
El 1 136.67
El 1 036.67
El 975.0
Minimum Water Surface El 935.0
El 935.76
El 1 036.67
S=0.8
El 978.0
El 1 036.67
S=0.8
El 978.0
El 1 036.67
(b)
S=0.8
El 978.0

FIG. 4. UPPER OUTLETS DISCHARGE PARALLEL TO FACE
(a) Horizontal Profile and Constriction at Outlet Prevent Sub-Atmospheric Pressure in Conduit
(b) Steps in Design of Elbow and Constriction

pressures within the conduits, (2) minimizing the formation of spray, and (3) minimizing the river-bed erosion.

The ideal solution for the conduit between the control gates and the face of the dam was to bring the outlets through the dam on a horizontal profile and to introduce an elbow at the downstream end, forcing the jets to flow parallel to the face of the dam, as shown in Fig. 4 (*a*). A reduction of area in the elbow would reduce the discharge, decreasing the velocity and increasing the pressure throughout the conduit. With this arrangement, the jets flowing down the spillway face would be less conducive to the formation of spray than those falling freely through the air, and the river-bed erosion would be minimized since the bucket at the toe of the dam would function as an energy dissipator for the outlets as well as for the spillway. The proximity of the elbow to the face of the spillway would be determined by the thickness of material necessary for structural purposes.

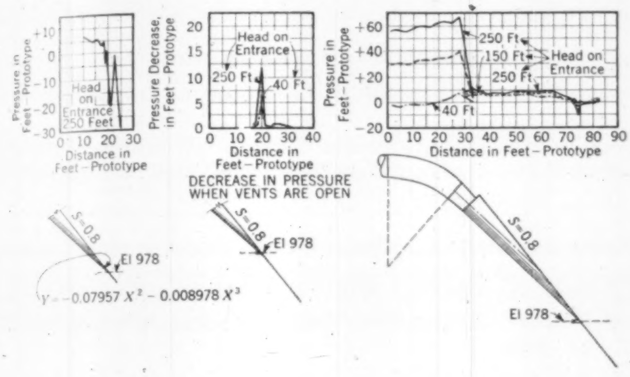

Fig. 5. Unexpected Low Pressures Encountered at Tip of Open Channel Slot

If the elbow were omitted, allowing the jet to discharge horizontally into the air, sub-atmospheric pressures would be entirely eliminated. Therefore the problem was reduced to the designing of an elbow with a constriction to maintain the positive pressures in the conduit, and an exit channel in the face of the spillway that would minimize spray and river-bed erosion. Successive stages in the development of this design are illustrated in Fig. 4 (*b*).

Since a sudden change in the alinement of a conduit may cause unfavorable local pressure distribution, the reduction in area in the first trial was effected by converging the crown of the elbow toward the invert. A minimum distance of 3 ft was established between the elbow and the face of the dam to allow for placement of adequate reinforcing steel in the concrete. The invert of the open-channel portion of the outlet was made circular in cross section and carried in tangent to the invert of the elbow.

The pressures in the elbow were above atmospheric, but the discharge was materially decreased. Fins of water formed on both sides of the jet in the upper end of the open trough. The fins were objectionable because of the spray released and because of the unpleasant appearance that would result when all 40 outlets were discharging.

In an effort to prevent the formation of these fins, a long succession of revisions in the shape of the open channel were undertaken. The solution finally obtained comprised a conical constriction symmetrical about the center line. This formed a slight, but definite, break at the intersection of the frustrum with the open channel. The pressures throughout the conduit were positive for all heads in excess of 40 ft on the center line of the entrance. The sub-atmospheric pressures that will occur when the outlet is operating under a head of less than 40 ft should do no damage in the short period of operation necessary during construction.

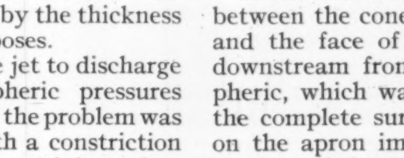

Fig. 6. Air Supply Piping at Lower End of Outlet

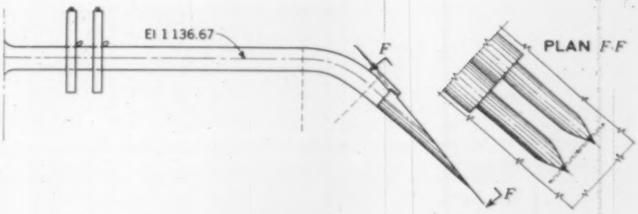

Fig. 7. Final Design with Deflector Over Exit

UNEXPECTED DISTURBANCES AT OUTLET TIP

The trough, or apron, portion of the outlets presented a problem of greater magnitude than originally anticipated. As the solution of the elbow and exit channel unfolded, the importance of the shape of the open channel became increasingly apparent. In the case of ordinary open-channel flow, minor surface irregularities are of relatively little importance, but this problem required a discharge surface that would reasonably fit a jet of water with a diameter of 7 ft 9 in. and a maximum velocity of 110 ft per sec. Any non-conformity tending to change the direction of this ponderous jet would result in unfavorable flow conditions. As in the case of the elbow, a step-by-step trial method was used to arrive at the final design.

In the first trial, a slight but distinct break was formed between the cone and the apron and between the apron and the face of the dam. The pressure immediately downstream from the cone was slightly above atmospheric, which was contrary to expectations. However, the complete surprise was the excessively low pressure on the apron immediately above the intersection with the face of the dam.

A number of changes in curvature and profile (Fig. 5) were made in attempting to solve this problem. None was successful. When the solution was found, it was quite by accident. Pressures in the elbow, cone, and upper portion of the channel were satisfactory; the jet of water was stable and undisturbed; the design of the conduit down to the end of the cone had been released to the design department for detailing; the simplicity of the design so far was encouraging. But what was to be done with this one remaining low-pressure condition? It appeared that the optimum design had been reached so far as structural treatment and visual observations were concerned.

One morning, after several weeks of study, the single-leg glass piezometer tubes were being replaced with U-tubes to eliminate the necessity of establishing a new datum plane after each change in the model. During the changing of the rubber connections, it was noted that the pressure downstream from any disconnected tube was increased. Air flowing into the disconnected tube aerated the low-pressure region. Why not install air vents for that purpose?

The air supply was taken from the face of the dam at a sufficient distance on both sides of the channel to prevent the outlet jets from covering the openings. The size of the air conduits was

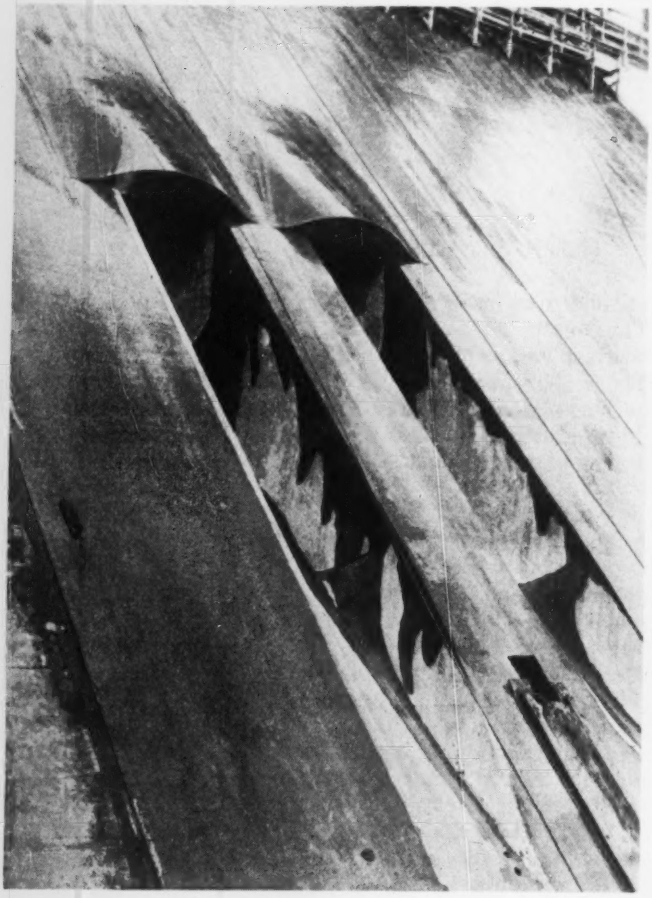

FIG. 8. COMPLETED EXIT PORTALS AT GRAND COULEE
Deflectors at Top; Ventilating Holes Just Discernible at Bottom

determined on the model by trial. In the prototype the header lines have a diameter of 6 in. while the feeder lines are 4 in. in diameter (Fig. 6).

The supposedly final design for the intermediate outlets at Grand Coulee Dam, which was developed under extreme urgency because of the progress of construction, did not have deflectors over the outlets (Figs. 7 and 8), although consideration had been given to the excessive spray from the water dropping into the channel of the outlet. Later tests, however, showed that for the condition in which the spillway operated alone such spray formation would be critical.

To eliminate this, the trajectory of the spillway jet was deflected above the opening in the face of the dam. The raised portion, or deflector, was made parabolic in the direction of flow and was blended into the spillway face by reverse curves.

With the addition of the deflector over the outlet, the thickness of concrete between the cone and the face of the deflector was increased considerably beyond the minimum established at the beginning of the studies as necessary for the reinforcing steel. Advantage was taken of these projections to move the elbow and cone 3 ft horizontally downstream. This change moved the point of intersection between the invert of the channel and the face of the dam up the slope 13 ft, reducing the exposed opening. Construction progress prevented any change in the intermediate outlets at Grand Coulee except the addition of the deflector, but the shortened opening and deflector were adopted for the upper tier in Grand Coulee and all outlets in Shasta Dam.

PROTOTYPE STUDIES PLANNED

The rapid completion of the prototype is expected to provide unusual opportunities for the comparison of field and laboratory work. The photograph, Fig. 9, shows the outlets operating at a recent stage of construction. Piezometer openings have been placed in the lining of the right outlet of block 51 in both the intermediate and upper tiers. A piping system connects these openings to terminal boards conveniently located in the inspection galleries.

Visually, the action of the prototype flow from the intermediate tier thus far observed has corresponded favorably with the model. The intake of air through the vents at the intersection of the apron with the face of the spillway also substantiated the model studies. Although the action of the deflectors with respect to the spillway flow cannot be ascertained until the dam is completed, their location with respect to the outlet jet permits ample inflow of air beneath the deflector. Further detailed comparisons between model and prototype results are to be expected after the dam is placed in regular operation.

The hydraulic laboratory in which these studies were made is a section of the Materials, Testing, and Control Division, supervised by R. F. Blanks and Arthur Ruettgers, both Members Am. Soc. C.E., senior engineers in the Denver office of the Bureau of Reclamation. Design studies and investigations are made under the direction of J. L. Savage, M. Am. Soc. C.E., chief designing engineer. S. O. Harper, M. Am. Soc. C.E., is chief engineer for the Bureau, and J. C. Page, M. Am. Soc. C.E., is Commissioner of Reclamation.

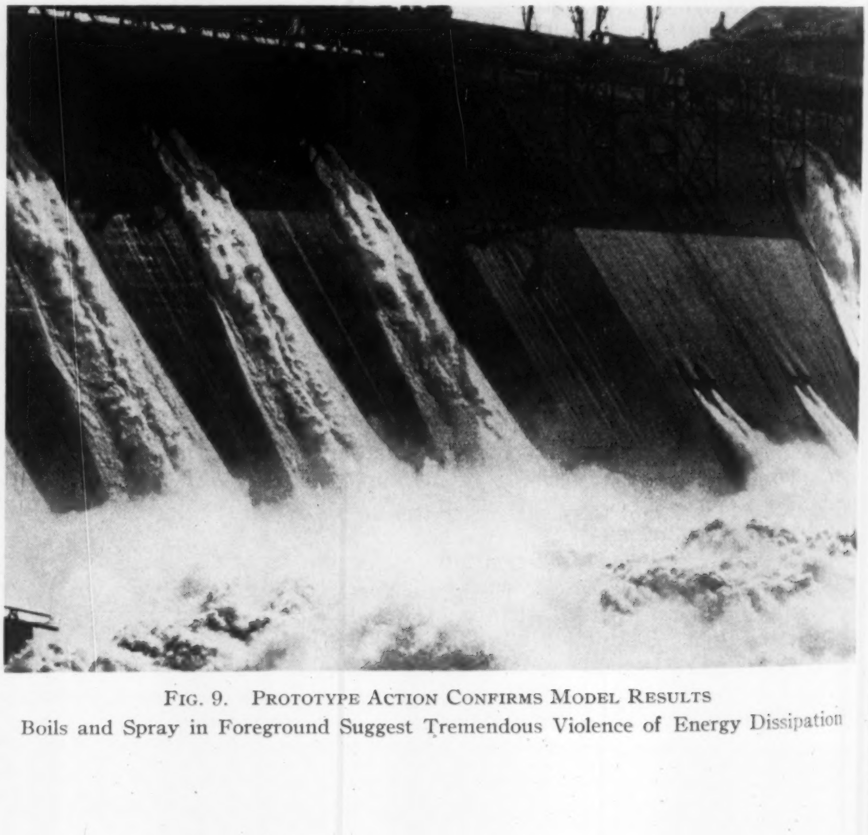

FIG. 9. PROTOTYPE ACTION CONFIRMS MODEL RESULTS
Boils and Spray in Foreground Suggest Tremendous Violence of Energy Dissipation

Practical Shear Tests for Foundation Design

Samples Extracted, Sealed, and Tested in Original Ring Container by Simple Process Give Bearing Values Consistent with Field Loading Checks

By TRENT R. DAMES

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FOUNDATION engineers have long recognized that sliding on shear surfaces is at the root of most important soil failures, but the difficulties in obtaining shear tests representative of the true strength of the soil in the undisturbed ground under an actual foundation have heretofore been considered nearly prohibitive. The procedure recommended here by Mr. Dames overcomes these difficulties, and affords a method that is cheaper and at the same time more comprehensive than the familiar field loading test.

IN solving any foundation problem the first step is a field exploration to obtain all information possible concerning subsurface conditions. The second step generally is to make field loading tests on test footings or test piles. However, this cumbersome procedure can be avoided by using, instead, the shear test method to be described. With this method representative soil cores are tested in sufficient number to establish their shearing and frictional strength and any other physical characteristics, such as compressibility, that may be important to a particular problem. With these data it is possible to predict closely the magnitude of, and variation in the supporting capacity which would be indicated by a large number of field loading tests. In addition, the shear tests make it possible to study the safety of stresses produced in the deeper soils by the action of the structure as a whole, a result not directly obtainable from loading tests.

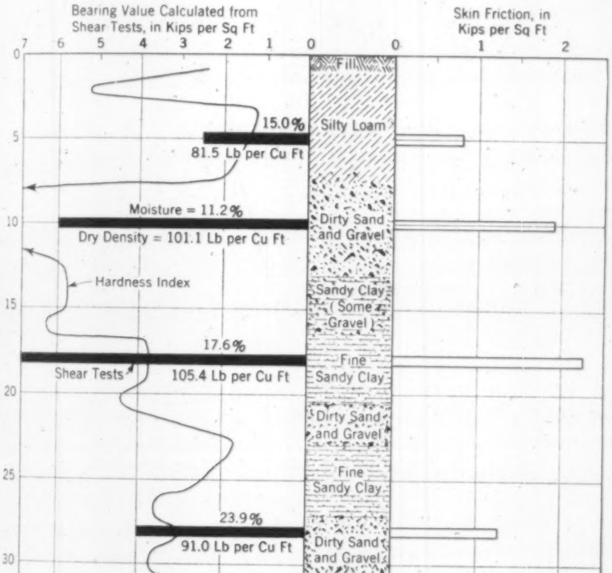


FIG. I. LOG OF BORING INCLUDES BEARING, HARDNESS, AND SKIN-FRICTION VALUES

In planning a program of foundation investigation, core testing, and analysis, the decision as to appropriate number, location, and depths of samples is of first importance. The core samples must be truly representative of the soils to be stressed by the completed foundation. The first exploration of the strong and weak portions of the substrata is often aided by an instrument recording the pressure required to force a steel needle into the soil (somewhat similar to the Proctor plasticity needle used in embankment control). The graph of soil hardness (Fig. 1) thus obtained aids in the selection of the locations at which core samples are to be taken, and permits an approximate interpolation of the supporting capacities between points at which shear tests are made.

A preferred method of exploration is to sink a drilled shaft, 2 ft in diameter (costing 25 to 40 cents per ft), into which an observer can be lowered to inspect the soils in place, make visual and instrumental examinations, and take core samples. Core samples taken in the 2-ft holes are obtained by using a hydraulic jacking device to force the sampling tool (Fig. 2) into undisturbed soil in the side of the boring. If only small-diameter borings can be put down, the core sampling tool may be driven downward into undisturbed soil. For explorations below the water table, small-diameter cased borings and the sampling tool shown in Fig. 3 are generally used.

The sampling tools shown have one feature that is not common, although a few such devices have been used elsewhere for several years—a series of brass rings 1 in. long by $2^1/_2$ in. in diameter, nested in the barrel of the tool to retain the cylinder of soil cut by the bit. These rings and their undisturbed contents are taken from the sampler barrel and immediately put into a supporting container which is promptly sealed. The core samples are kept in their ring containers throughout the entire process of handling and testing so that there will be no opportunity for the soil particles to lose or change the interrelationship that existed before the sample was taken. This precaution is absolutely necessary if reliable results are to be had.

The disturbed zone of the sample has been observed to be confined to the outer $^1/_8$ in. This disturbance is only

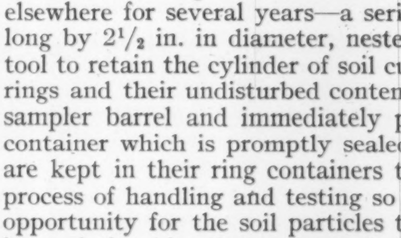
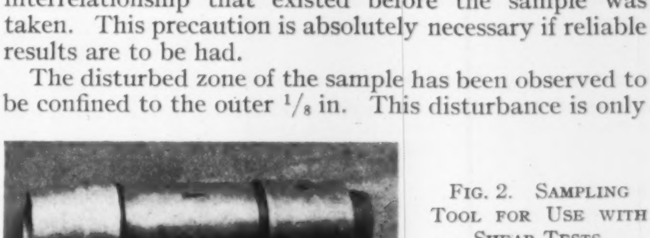


FIG. 2. SAMPLING TOOL FOR USE WITH SHEAR TESTS



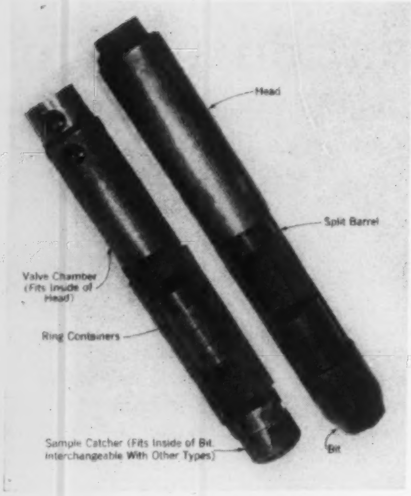

Head
Split Barrel
Valve Chamber (Fits Inside of Head)
Ring Containers
Sample Catcher (Fits Inside of Bit. Interchangeable With Other Types)
Bit

FIG. 3. A MORE ELABORATE UNDER-WATER SAMPLER

partial, much less than would occur if an oversized sample were taken and later subjected to the handling involved in trimming it to the size required for testing. In addition, the ring containers permit the ready sampling and testing of sands and friable sandy loams that could not be subjected to the trimming method. The large reduction in time and cost of testing achieved with the ring sample containers is very important in commercial work.

For shearing these samples, the writer has developed the testing machine shown in Fig. 4. Three of the ring containers are held in such a way that the middle ring can be moved out of line with the other two by applying the shearing load. The three containers are placed in a carriage (*A* and *A'*) so arranged that all three rings are permitted longitudinal movement while only the center ring is permitted shearing movement. When the sample is adjusted, confining load or surcharge (compression) is applied to the ends of the cylinder by weights operating through a lever system (*B*). The amount of this surcharge is normally made equivalent to the weight of the overburden but it may be varied at will to study other conditions. Compressive or expansive longitudinal movements during the testing of the sample are measured by a micrometer dial (*C*).

When compression of the sample has ceased, the shear test proper is started. The lower half of the carriage (*A'*), here removed to show a partially sheared sample in its container rings, has been previously locked in place. The center ring is attached by a yoke to the shearing lever system (*E*), and shearing movement is measured by a micrometer dial (*D*). Dead load is usually applied in uniform increments at uniform intervals of time, and the deflection readings of dials (*C*) and (*D*) are recorded for each increment until failure occurs. Plotting the readings produces two load-deflection curves like those in Fig. 5. From these curves the shearing strength of the sample is determined for the surcharge and moisture conditions obtaining during the test.

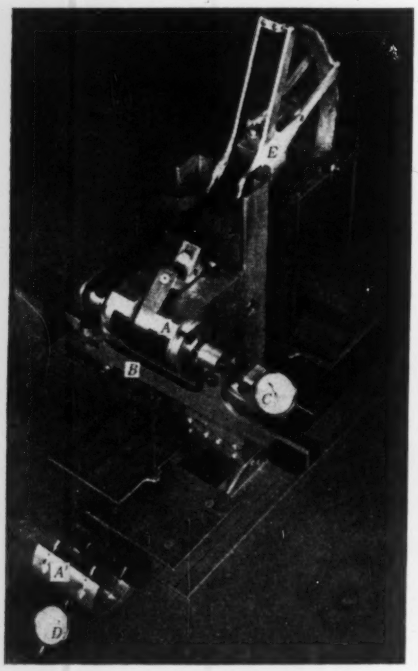


FIG. 4. COMPACT SHEARING UNIT
Segmental Lever Keeps Mechanical Advantage Constant as Sample Deforms

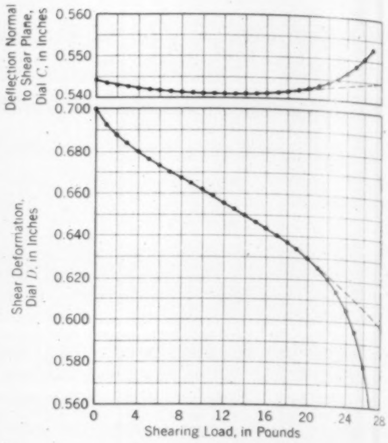


FIG. 5. STRESS-STRAIN CURVES FROM THE SHEAR TEST

In the vast majority of cases, the curve of load against shearing deflection is sufficient for a determination of shearing strength, but cases arise where the curve of load against longitudinal deflection more clearly defines the failure of the soil. In some soils, particularly certain clays, a knowledge of the rate of deflection under successive increments of load is required in order to select the critical value. Very frequently a double-logarithmic plot of data will define a sharp yield point even though the arithmetic plot has a continuous curvature.

In analyses of spread foundations based on tests of core samples, it is assumed that in the soil below any loaded footing there are shearing as well as direct stresses, and that when the shearing stress exceeds the shearing strength, plastic flow occurs. At this point the footing has reached its limit as a load-carrying agency. The stress relationships involved in these assumptions are developed by S. Timoshenko in his book, *Theory of Elasticity*, and by A. Nadai in his *Plasticity*.

An actual zone of shearing failure and plastic movement was disclosed under an overloaded footing recently excavated. It is faintly but unmistakably discernible in the photograph, Fig. 6, and its pattern resembles the slip lines visible in etched specimens of overloaded steel. The footing supported a bearing wall of a two-story masonry school, one wing of which was torn down largely because of this failure.

The correlation of theory with experiment has been accomplished by a direct comparison of (*a*), the loads at which field bearing tests yielded, with (*b*), the computed yield points based on the shearing strengths of the supporting soils as determined by tests on samples extracted from the particular soils loaded by the test footings. In the earlier comparisons, made while the writer and his partner were in the employ of the firm of Labarre

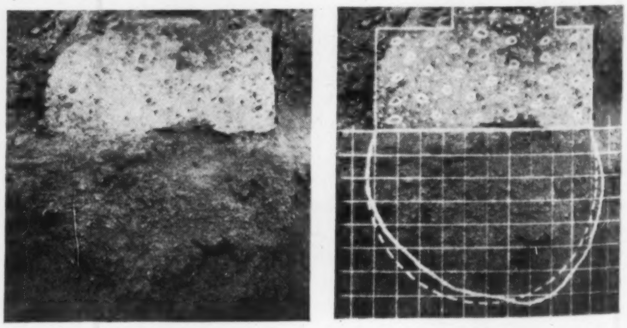


FIG. 6. ACTUAL SLIP LINE CONFORMS TO THEORETICAL
Fracture Surface Is Traced with a Continuous White Line in Right-Hand Picture; Broken Line Defines Calculated Position of Failure

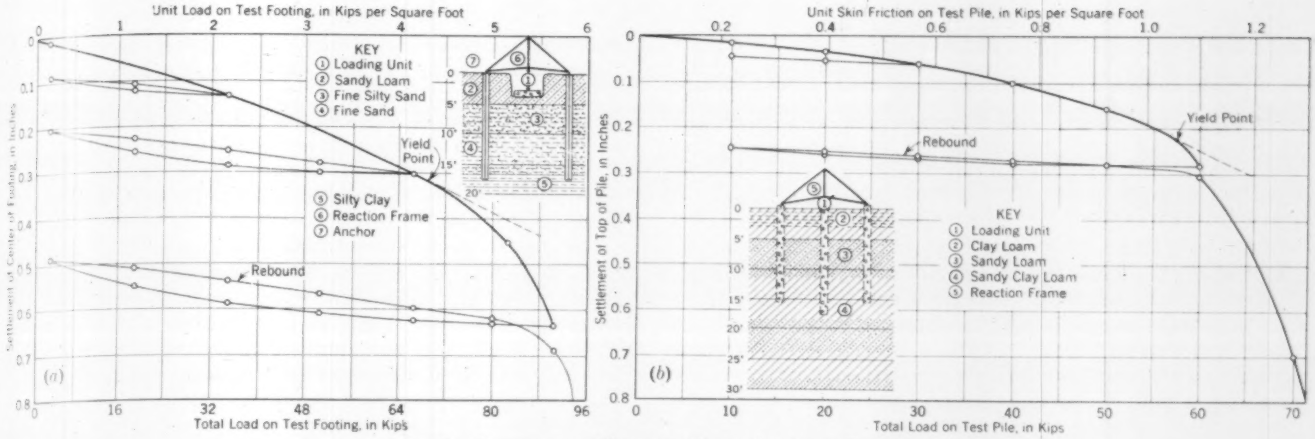


Fig. 7. Results of Typical Field Loading Tests
(a) Spread Footings; (b) Cast-in Place Piles

and Converse, the area of the test footings used ranged from 2 sq ft to 9 sq ft. More recently, the sizes of test footings investigated have been increased to 16 sq ft.

In summarizing the results of correlations between loads, shearing stresses, and plastic flow, it should be noted that the load at which shearing stress exceeds shearing strength is the "yield point load" determined by field load tests accurately conducted in suitable increments (Fig. 7, *a*). The load at "yield point" divided by the shearing strength of the soil gives results which, for the available record of tests, can be plotted as shown in Fig. 8. A probability curve put through this diagram gives a most probable ratio of 3.25, as indicated. The ratio derived theoretically by Nadai is 3.14. The difference may be due in part to the crudeness of some of the earlier testing methods, but in any event the agreement is reasonably close. More recent tests give values consistently within 10% of the most probable value. However, a certain spread with soil type is observed; ratios greater than 3.4 invariably are for sand, while ratios less than 2.8 usually represent a type of silty clay whose freshly broken surface appears as a silky fracture.

On the load-settlement curve in Fig. 7 (*a*), the slight change of slope at 2,500 lb per sq ft agrees with a corresponding value computed from the shearing strength of the soil at the edge of the footing and represents a local yielding of the unconfined soil at that point. This is not significant in determining the safe loading, for the pressures merely redistribute themselves under the footing as the soil continues to carry increasing loads until the primary shearing failure occurs.

The shear tests may be performed either at field moisture or under the softening influence of increased moisture, which is applied to the sample in the laboratory through porous stones while the sample is confined under its natural surcharge. Tests of this latter type are of great importance where investigations conducted at the end of a long drought must be the basis for predicting the behavior of foundations that will be subject to wetting by irrigation or heavy winter rainfall. A typical example of the variation of bearing value with moisture content is given in Fig. 9.

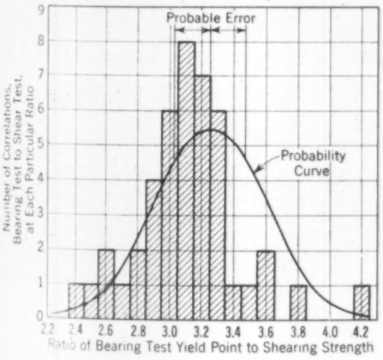


Fig. 8. Probability Curve of Shear Strength–Bearing Value Ratios

A newer use for shear tests is the prediction of the load-carrying capacity of piling. This use was first applied to a type of cast-in-place pile formed by boring into the ground with a power auger and filling the resulting hole with concrete in complete contact with the soil. The foundation thus formed depends on "skin-friction" for its supporting value. Observations on such foundations used for a number of years in the weaker soils of Southern California seem to indicate that the bond between concrete and soil has more strength than does the soil itself.

If this is true, the ultimate failure of such a pile support would be in straight punching shear along a cylindrical surface in the soil immediately outside the contact between soil and pile. It has been possible to confirm this logical relationship by comparing the supporting value of the pile as computed from the measured shearing strength of the soil with its supporting value as determined by actual load test. Three checks within an accuracy of 5 or 10% have thus far been obtained, and a typical example is shown in Fig. 7(*b*).

These indications of success with drilled cast-in-place piles suggested the application of the method to driven types of piling. Two new factors were found to be important: (1) The friction of the pile material on the soil may be less than the shearing strength of the soil; and (2) in displacement piles, the shearing strength or friction developed is frequently that corresponding to a pressure greater than the confining overburden.

The value of the friction of the pile material on the soil is ascertained by substituting a disk of the pile material for the center of the three rings of the shear test and making a friction test. Friction values obtained in this manner have agreed well with the results of load tests on steel H-piles, which cause little displacement of the surrounding soil. In soft, saturated clay where no compaction could occur during the driving of displacement piles, the load-

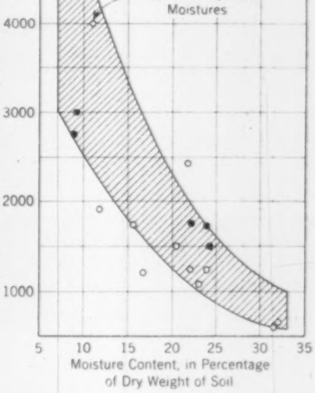


Fig. 9. Influence of Moisture Content on Bearing Value

carrying capacity of some wood piles agreed closely with the shearing strength of the soil.

On the other hand, where compaction increased the pressure of the soil against the pile, it was found that driven, cast-in-place, and pre-cast concrete piles carried loads that could be evaluated by means of friction tests made under a pressure approximating the ultimate passive pressure indicated by the shearing strength of the soil penetrated. In some cases special types of consolidation tests may aid in evaluating the permanency of these pressures built up around the pile during driving.

The shape of the load settlement curve in Fig. 7(*b*) is characteristic of many pile tests on both drilled cast-in-place and driven piling. While a precise determination of the yield point is difficult and uncertain from the arithmetic plot, it has been found that almost invariably a clear and definite yield point may be established by plotting both the load and the settlement to logarithmic scales. The portions of the curve below the yield point will then appear as a straight line while those above will be curved.

Available checks are of course too few for certainty, but their agreement with the logical background and with the performance of existing installations is good. The writer has used the shear tests and friction tests, with a suitable safety factor, for designing a number of pile foundations when the possible savings did not justify confirming load tests.

The methods of investigation and analysis outlined make it possible to obtain, at a reasonable cost on any specific project, data that will establish working load limits for different types of foundations at all feasible depths. With this information a logical selection may be made of the foundation best suited to requirements. The information furnished by shear tests is in many cases sufficient for the final design. On important or unusual work supplementary information will usually be secured from settlement studies and field loading tests.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Handy Chart Counts Bar Spaces

By ARTHUR DELAFIELD JOHNSON, JUN. AM. SOC. C.E.

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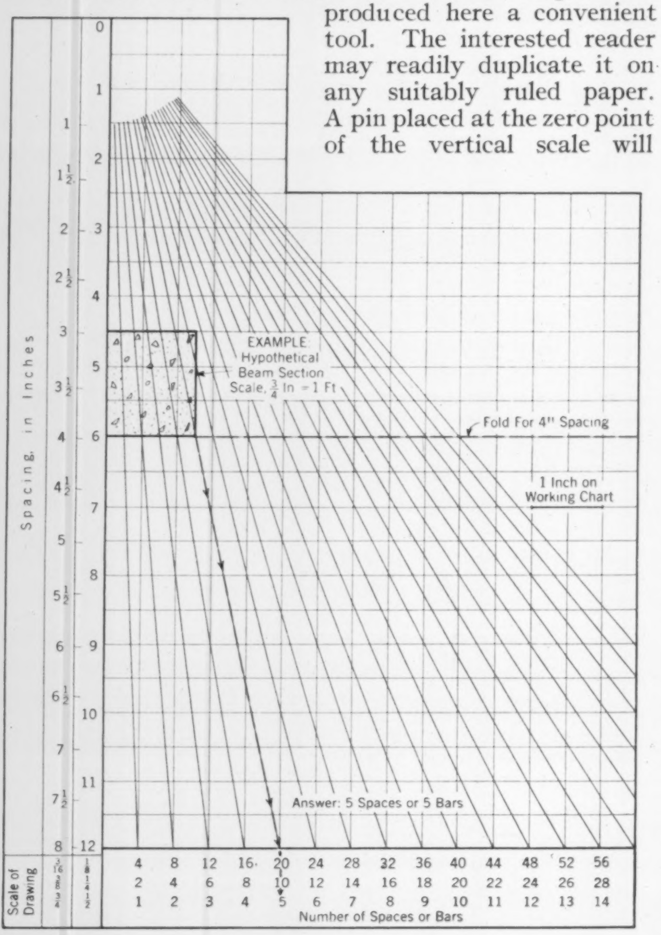
FOR problems in the spacing of bars in reinforced concrete work, the writer has found the diagram reproduced here a convenient tool. The interested reader may readily duplicate it on any suitably ruled paper. A pin placed at the zero point of the vertical scale will facilitate construction. To apply, fold on the horizontal line corresponding to the desired reinforcing bar spacing, place the folded edge on the drawing, and read the number of spaces or bars at the bottom of the chart opposite the terminus of the diagonal line indicated at the folded edge; or conversely, for a given number of bars at the bottom, follow the diagonal line up to the intersection with the vertical at the appropriate width, and read the proper spacing horizontally opposite. (Number of spaces is assumed equal to number of bars when edge distance is one-half of one space.)



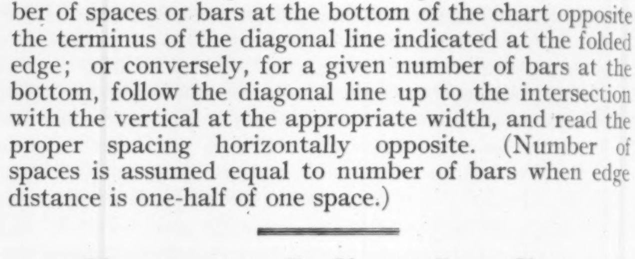
Shortcut to Indirect Leveling

By WILLIAM H. ALSUP, JUN. AM. SOC. C.E.

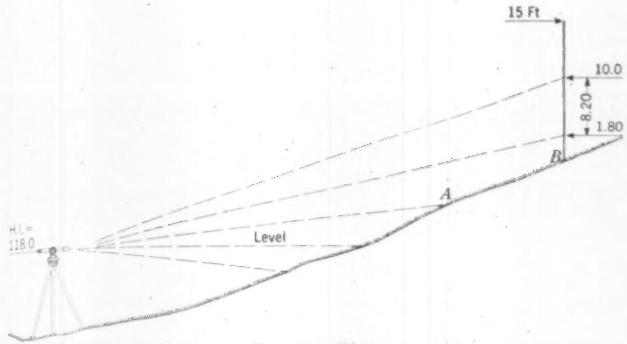
LAUREL, MISS.

WHEN the permissible error of closure is one foot, and when accurate control lines have been established approximately ten miles apart, the methods of leveling described here have been found highly satisfactory. The one-half step method is illustrated in Sketch (*a*). With telescope level, note that the lower hair intersects the rod at 10.50. Then lower the telescope and observe the half stadia interval, say 7.50. This makes the H.I. = B.M. Elev. + 10.50 + 7.50 = 118.

To use the step method shown in Sketch (*b*), with telescope level, find a temporarily stationary object (flower, tree, weed, or the like) intersected by the upper hair;



SKETCH (*a*)



Sketch (b)

then with the eye to the telescope raise the telescope until the lower hair intersects the selected object. The middle and upper hairs then lie on the rod as at 1.80 and 10.00, respectively. This establishes the half stadia interval of 8.20, and the elevation at *B* becomes H.I. Elev. (or 118) + 2(8.20) − 1.80 = 132.60.

Continued use of these methods has demonstrated that the error introduced by using the rod interval at random inclination to the line of sight is adequately compensating. An angle shot is recommended when the difference in elevation is greater than $1^1/_2$ steps, but by combining the step methods with angle shots and direct levels both speed and accuracy can be obtained.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Military Airports

To the Editor: In the current issue, Mr. Hersum advocates protection of military air fields against bombing attacks and cites some of the possibilities of camouflage, decentralization, and cover.

The problem of a "bombproof" hangar should be comprehended in its full magnitude—no half way compromises. It would be well, perhaps, to emphasize that protection against incendiary and light bombs only does not constitute bombproof protection. Consideration must be given to 2,000, 4,000, and even 6,000-lb projectiles released from 20,000 to 30,000-ft heights with a consequent kinetic energy of 180,000,000 ft lb.

Such projectiles would penetrate in plastic clay, 70 to 80 ft; in loose sand, 60 to 70 ft; in solid reinforced concrete, 25 to 30 ft; and in laminated reinforced concrete, 12 to 15 ft.

Since the requirements of a bombproof shelter in earth consist of a cover of, say, 100 ft, the roof load will be about 10 kips per sq ft. A bomber's wing spread demands a span of 200 ft. Thus, the roof is loaded with about 2,000,000 lb per lin ft. Such heavy loads and big spans suggest the following considerations:

1. Slab roofs may seldom be feasible, and trusses for such loading would be 30 to 40 ft deep.
2. Arches, preferably laminated concrete arches or of barrel-shell type, are a logical form of structure for such loading.
3. The use of laminated flexible reinforced concrete slabs to protect the arch would reduce the depth of earth cover and, consequently, the arch thickness.
4. Heavy foundation loads of 1,000 tons per lin ft require special footings and anchorages and might, therefore, necessitate rock foundation or piles.
5. The cost of such a hangar might run as high as $5,000 per lin ft; the housing of a plane 150 ft long might cost $750,000.
6. Burying the structure introduces the problems of ground water, excessive lateral pressure, excavations, exits, and ramps, all adding to the costs. Covering, on the other hand, would permit original construction on the surface, with earth protection added later.
7. The unusually heavy load requires unusual structures. The possibility of developing new materials of higher elasticity and tensile strength should be considered and investigated—also, the loading of present materials up to their elastic limits; or of having over-rigid frameworks with hinged, collapsible wall panels. Brick, a material without tensile strength, is of no purpose. The complete failure of brick walls can be seen on pictures from Europe—they do not resist the action of even the smallest explosive bomb.

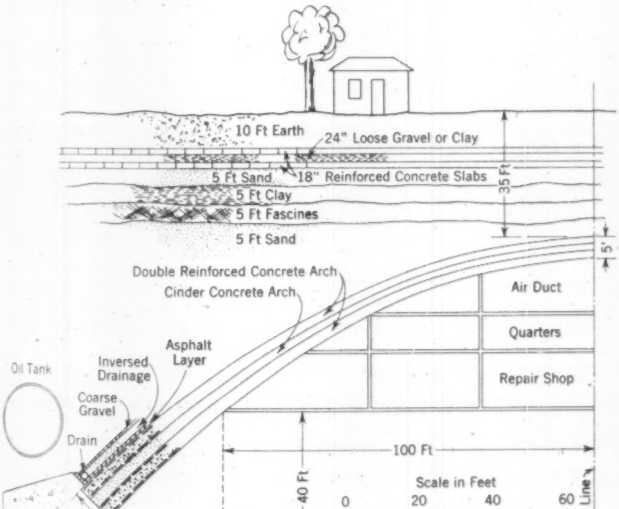


Fig. 1. Laminated Arch for a Bombproof Hangar

Because the unique problem involves also vibration, impact, suction, and other forces, too much time should not be spent in trying to apply the conventional types of construction; instead the ingenuity of American engineers should be directed toward creation of new and progressive forms. The laminated arch in Fig. 1 is a suggestion.

The principle of decentralization of personnel is sound. However, ground and craft forces should be located near their planes, or provision should be made for rapid transportation. Burying utility lines "beyond all possible danger" means a depth of 100 ft. Double or triple lines properly interconnected and at shallower depths might be more practical. Placing of oil tanks and supplies below the hangar, in case of explosion, might cause the whole hangar to be damaged. If the oil tanks were placed on the side and at somewhat higher elevation, the flow could be by gravity and any explosion would be less disastrous.

The writer feels there is little difference between military and civilian air fields in time of war. Both can be used for military purposes and should be appropriately equipped therefor. With respect to over-arching of stresses around a hole, in view of the high speed of impact (1,000 ft per sec), it is doubtful whether stress transformation in a rigid material might occur in such a short interval. If the "arching" would not occur, structures dependent on such arching might fail. Also the suggestion that the runways be above the hangar exposes two vital elements to a single projectile. A normal runway may be quickly restored by filling the crater with earth (bulldozing), but the repair of a runway over a damaged hangar roof would be less simple.

The writer wishes to compliment the author in tackling the subject of military air bases, a subject which in this country, is still in the pioneer stage. It is to be hoped that his paper will stimulate a further exchange of engineering ideas on this purely engineering problem.

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Consulting Engineer
Brooklyn, N.Y.

Advantages of Heavy Roller

TO THE EDITOR: In "Modern Construction Methods on Earth Dams—Part II," in the September issue, in connection with the compaction tests conducted at Wappapello Dam, Mr. Floyd states that the possibly slight advantage of the heavy roller would not justify the increased cost of purchasing and operating such rollers. This statement is correct for the particular case in question, inasmuch as a change order, involving additional costs to the government, would have been required. However, if the results of the field compaction tests had been available at the time when the specifications were drawn up, the undersigned would have favored the use of the heavier rollers in view of the following facts.

The natural water content of the borrow material was, in general, from 3 to 4% below the optimum water content for the specification sheepsfoot roller except during the rainy season when dirt-moving operations were, of necessity, considerably curtailed. Thus, during the major portion of the working season, it was necessary to add water to the material. This water was added on the embankment, partly prior to placing fresh material and partly after spreading operations. The general run of material contained an average of about 20% clay sizes and was sufficiently impervious so that the added water, particularly that on top, would not penetrate the entire layer unless special measures were taken to effect it. Further, it was found that delay between the spreading of the material and rolling, resulting from the time required for removal of over-size rock, would frequently result in a hard crust on top of the spread layer due to surface drying. Attempts to break up this crust and mix the material by means of a few passes of a light scarifier did not meet with much success, and it was soon found that unless some more positive means of mixing were employed, the specification roller would, in many places, either ride the top crust, the feet not breaking through, or, where the rolling followed the wetting more closely, penetrate the top inch or two of soft material and ride the middle of the layer where lack of moisture and the presence of rock fragments prevented penetration of the entire layer. The behavior of the heavier sheepsfoot roller was in direct contrast to this, the feet (10 in. in length) penetrating through the unsoftened or rocky portion of the layer and breaking it up effectively with attendant distribution of moisture.

In order to obtain the desired degree of compaction with the use of the specification roller, the following requirements were necessary (1) rigid control of the moisture content of the placed material, and (2) control of the distribution of the moisture throughout the layer prior to rolling by mixing operations.

On the other hand, tests made with the heavy roller showed that the desired degree of compaction could be obtained, during the normal working season, with no control of the water content. Both requirements listed above involved considerable expense both to the contractor and to the government. It appears that the total expense of such, over the entire length of the job, would exceed the additional expense involved in the use of the heavier rollers. In addition, a more uniformly dense embankment would have been obtained by use of the heavier roller.

Vicksburg, Miss.

W. L. WELLS, Assoc. M. Am. Soc. C.E.
Assistant Engineer, U.S. Waterways Experiment Station

Buying Coal on a Btu Basis

TO THE EDITOR: In connection with the subject of coal for power generation, presented by Mr. Thomas at the Spring Meeting of the Society and abstracted in the August issue of CIVIL ENGINEERING, the experiences of the Kansas City Power and Light Company may be of interest.

Statistics cited by Mr. Thomas show that the average cost of bituminous coal mined in the United States in 1928 was $4.12 per ton delivered. This dropped to $3.55 in 1933 and was back up to $4.01 by 1935, 2.75% lower than the 1928 price. There can be no question but that these figures are correct and represent the "average" selling price of all bituminous coal mined. However, they are far from correct for the cost of coal for the production of power in Kansas City, where during these same years the cost dropped over 37$^1/_2$%. Furthermore, if we bring statistics for this city up to date and include the average cost of coal in 1939, the drop is over 42.5% of the cost per ton of coal delivered in 1928, and with the lower cost of fuel has come improvement in power plant equipment, resulting in the use of less fuel per kwhr just as Mr. Thomas shows in his statement concerning the Detroit Edison Company.

All fuel purchased by the Kansas City Power and Light Company is purchased on a Btu basis wherein the shipper is paid a premium if he exceeds his guarantee point, and in the majority of cases the shippers do exceed their guarantees and are paid more for a ton of coal than they originally asked.

Purchasing coal on a Btu basis is the only logical and fair method of purchase. The shipper has an incentive for shipping cleaner coal because he gets a better price for his product. He ships fewer tons but gets more money per ton. The customer has a better quality of coal, handles fewer tons of coal and ash, and pays no more per million heat units. The only loser is the railroad company, which collects less freight. However, Mr. Thomas brings out the fact that in most cases the railroad gets more for hauling the coal than the coal company gets for producing it, and selling coal on a Btu basis may be one way of diverting money from the railroads' pockets to the coal companies' pockets.

It is not uncommon to reduce the ash content of coal from 6 to 8% by washing or to increase the heat content 1,000 Btu. If we apply this process to 11,500 Btu Kansas screenings with a freight rate of $1.35 to Kansas City, the shipper would ship only about 920 tons instead of 1,000 tons and would receive about 22 cents a ton more for his coal, based on present prices.

Missouri mines that once were shipping 9,700 Btu coal (before it was purchased on a Btu basis) are now shipping 10,500 Btu coal without washing. Obviously they have found that cleaning, at least to this extent, is profitable.

In this limited discussion I have attempted to cover just one point that I believe will be of benefit to both the shipper and the consumer—that is, buy coal on a Btu basis, receive cleaner coal, and pay less freight.

E. L. MCDONALD
Results Engineer, Kansas City Power and Light Company

Kansas City, Mo.

Land Subdivision Problems

TO THE EDITOR: In connection with Mr. Kinslow's article on "A Graphical Method for Land Subdivision Problems," in the August issue, it seems to me that such appropriate occasions for accurate computations by the use of the calculus should not pass without comment.

For instance, after solving triangle ABJ (Fig. 1), assume BJ the y-axis and JD the x-axis. Then the equation of the line BC becomes $y = mx + b$, where m equals the tangent of the line with the x-axis and b equals the intercept of the line on the y-axis, and the remaining area desired equals $\int_0^a y\,dx = \int_0^a (mx + b)dx = \frac{ma^2}{2} + ba$, where a may be computed as the required distance along the x-axis from J to E.

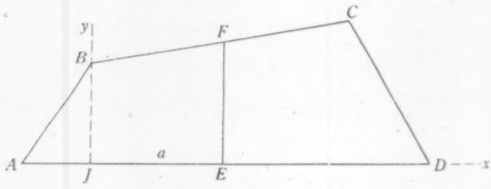


FIG. 1.

Computations of this type can usually be made quite simple by properly choosing the origin and orientation of the axes.

Scappoose, Ore.

H. G. PALMBERG, Assoc. M. Am. Soc. C.E.

[*Editor's Note*: In connection with W. G. Frost's discussion of Mr. Kinslow's article, which appeared in the October issue, the quantity $\frac{JB}{\tan FBH}$ in the equation for determining the value of JE should be negative instead of positive.]

Trouble Ahead!

To the Editor: In consonance with the "good neighbor" policy and the Buenos Aires and Havana conferences a half billion more has been added to the $200,000,000 American taxpayers' dollars available for Latin-American export-import bank loan distribution.

On the face of it this is high statesmanship; the European War has paralyzed the export market for the South American area and the resulting economic conditions make it ripe for Hitler's future complete economic penetration and subjugation. But the unpalatable truth is that these countries have already scorched the fingers of the American investing public, to a present total of $1^{1}/_{4}$ billion post-war unpaid loans; they rate as liberal borrowers and tragically poor payers. And, to make matters worse, with the exception of coffee, their products of cotton, meat, wheat, copper, and so on, are the very things of which the United States already has great surpluses.

The writer's 28 years' residence in, and consequent observation of, Latin-America give him uneasiness concerning the possible outcome of these loans. Lovable, hospitable, and cultured as so many Latin-Americans certainly are, nevertheless one wonders if due and realistic consideration will be given by the managers of these loans to the psychology of native leaders and populations concerned. Do we realize how often weak or unfitted, self-seeking or actually adventurous leaders "boil to the top" in the politics and government of those countries? Such countries tend to lack the great middle class that so makes for stability in a republic.

With weak nations everywhere trembling for their future economic and political survivals Tio Samuel (Uncle Sam) just now is a haven in time of storm to Latin-America; he looks to them like the benevolent old gentleman the cartoonists like to picture. But what of the future? Does one love the man to whom money is due—and overdue? It's so much nicer to borrow than to repay! Let us not fatuously believe the German merchants (who locally everywhere down there exchange their wares in trade for the grower's raw products), already deeply entrenched through local ties of marriage, credit, and politics, will miss their chances for local and effective anti-American agitation. Then the day of reckoning comes. The now benign export-import bank loans will then rate as Shylock's doings that were masqueraded as Santa Claus's.

And the El Coloso del Norte (the Northern ogre) idea and slogan, now buried by current events, the indulgent smiles of "good neighbors," and idealistic hopes, can later be made to sound as threatening, indeed, to barefoot José and Juan or a supersensitive nationalist.

In the desideratum for caring for Latin-American trade, economy, and independence now, let us earnestly hope the loans are to be made with infinite wisdom. Otherwise they may beget situations as bad or worse than the ones they cure. And it would be silly, indeed, to repeat the absurdities of the Latin-American 1920–1924 loans of lamentable memory simply because American idealism and defense hysteria had blinded our common sense and realism.

Rochester, N.Y. Ralph Z. Kirkpatrick

Study of Engineering Trends

To the Editor: The article by R. O. Thomas on "Engineering Trends in California," which appeared in the July issue, presents some worth-while statistical data that are significant of and parallel to the national trend. The resulting analysis of factual data is indicative of a definite trend towards a horizontal line—routine technicians—wherein the freedom of opportunity is curtailed.

Will those junior engineers, of whom 52% were in public service in 1940, be rewarded for their ability, initiative, and hard work? Most of them will be submerged below the horizontal line where their identities are lost in civil service or within the machinery of corporations. Very few will ever reach the independent status of a consulting engineer.

Today most of the young graduate engineers who have received their B.S. or M.S. degrees are confronted with the serious problem of obtaining employment suitable to their professional requirements. Approximately 10,000 men in the United States receive engineering degrees annually, and there are 50,000 engineering students attending our universities. In addition, the junior colleges are producing subprofessional or semi-professional engineers—in other words, technicians with at the most two years of junior college work—who are in a large measure in competition for jobs with the young graduate engineer with his B.S. or M.S. degree. What is the saturation limit? Can industry properly absorb the increasing product of our colleges? I think not. On the other hand, our national defense program will temporarily help to take up some of the slack, mostly in non-productive or military work. After the national defense activities have spent their force and the world is bankrupt, then "après moi le déluge."

Mr. Thomas's analysis shows that in a 15-year period those engaged in private practice decreased from 30 to 14%. Why? I think the most important reasons are the following: (1) Governmental policies tending towards unlimited socialization and regimentation; (2) competition by salaried engineers, particularly those on public payrolls who are permitted to do private consulting; (3) competition by collegiate instructors who have practically no overhead costs and who are in most cases on public payrolls; (4) competition by industries that provide "free engineering service"; (5) competition by the "engineer-constructors" who are in reality contractors furnishing engineering design services; and (6) competition by unscrupulous and generally low-grade practitioners and some architects who hire technical help at low wages.

Will our national engineering societies do something constructive to correct these existing conditions? The welfare of the engineering profession demands definite action before it is too late.

R. M. Beanfield, M. Am. Soc. C.E.
Los Angeles, Calif. *Consulting Engineer*

Spillway Coefficients from Model Tests

To the Editor: I was interested in Mr. Offitzeroff's article on "Model Studies of Overflow Spillway Sections," in the August issue. The unusually high coefficients there reported undoubtedly result from the formation of areas of negative pressure immediately below the crest which in effect increase the total head acting on the spillway. Tests on small scale models may involve negative pressures of such magnitude that they cannot be realized on the prototype. Similitude is achieved and the model results are transferable to the prototype as long as neither the model pressures nor the corresponding prototype pressures reach the vapor pressure of the water, at which point cavitation begins. The actual magnitude of the air pressure on the water surface is of no consequence as long as both model and prototype pressures are kept above the vapor pressure. This has long been recognized and applied in turbine testing, particularly with respect to the cavitation limit. In the case of spillway models, it is easy to measure pressures at points of sharp curvature and discard all test results in which impossible prototype pressures occur.

Reduction of the overlying atmospheric pressure to the same scale as the linear dimensions of the model would prevent the prediction by the model of impossible negative pressures in the prototype. It would not insure complete similitude. Because discontinuity of flow begins at the vapor pressure, and because the vapor pressure is independent of the model scale, the usefulness of such a model would be very seriously limited.

Consider a 1:15 scale model using water at 68 F and with the overlying atmospheric pressure of 33 ft of water reduced to one-fifteenth or 2.2 ft. In such a model, absolute pressures below 0.77 ft of water, which is the vapor pressure at this temperature, cannot exist. The corresponding absolute pressure in the prototype is 11.5 ft. It is clear that the model cannot reproduce the range of prototype pressures which exist between 0.77 ft and 11.5 ft. Consider again a model scale of 1:30 and a water temperature of 86 F. At 86 F the vapor pressure is 1.40 ft of water. An attempt to operate a 1:30 scale model with the atmospheric pressure reduced to one-thirtieth, or 1.1 ft of water, would result in the prompt evaporation of the model water supply. The conclusions regarding the prototype, which would be drawn from the experiment, are clearly of questionable value.

G. H. Hickox, Assoc. M. Am. Soc. C.E.
Senior Hydraulic Engineer,
Norris, Tenn. *TVA Hydraulic Laboratory*

Submerged Dam Experiments

TO THE EDITOR: I feel obliged to call attention to some misconceptions that exist in Mr. Offitzeroff's article in the August issue.

It is stated that the effect of submergence on the discharge is independent of Q and H and that "In this respect our data fully coincide with the American data." The data to which reference is made are the well-known and much-quoted submerged dam experiments reported by the U.S. Deep Waterways Board. The tests were made under a constant head. For this reason, no variation with H was possible nor could any tendency towards variation with Q have been detected.

Elsewhere in the article, the direction of flow with respect to the dam used by the Deep Waterways Board is incorrectly stated. The fact that the downstream rather than the upstream face was vertical and the ratio of head to height of dam—6.6 ft and 5.28 ft, respectively—makes the dam even more atypical than indicated.

In view of the author's statement that the "results. . . are still enjoying a merited success both in the United States and in Europe," it seems desirable to call attention to these peculiarities.

EDWARD SOUCEK, Jun. Am. Soc. C.E.
Associate Hydraulic Engineer
The Panama Canal
Balboa Heights, C.Z.

Reclamation Extravaganza?

DEAR SIR: In the October number of CIVIL ENGINEERING the Commissioner of Reclamation, John C. Page, presents a "Broad View of Reclamation." I should like to comment on certain quotations from that article.

In answer to Mr. Page's statement that, "For the last 15 years . . . the federal government has been virtually the only agency engaged in irrigation development," it may be pointed out that this is true because such developments are necessarily so costly that they are not economically justifiable or profitable for private enterprise or for farmers on the basis of enterprise or for farmers paying the cost. For the same reason, the consumer cannot afford the luxury.

The "2,500,000 additional acres" to be irrigated according to the Bureau of Reclamation's "construction program" will not support a million people, on the basis of said people being self-supporting and repaying the cost of reclamation. The excess cost of the present great and costly construction program will have to be paid out of the public treasury, thereby laying an excess and unnecessary cost upon the nation's food supply. Without the additional acreage, the nation is producing more than enough food. The government is saying that existing acreage is too great and is reducing it.

The water shortage and consequent "desolation or stagnation" exist because irrigation acreage has been unwarrantably extended as is now evidenced by devotion of about one-half of a great and costly program to rehabilitation projects. Upon the nation's food supply, excess cost upon excess cost is being laid, and again the public treasury must carry the load.

The Grand Coulee Dam is an unprecedented extravaganza for which there is no possibility of justification in irrigation development. The nation cannot afford to pay the excessive cost of any food produced thereby. In lesser degree, this is also true of the Hoover Dam. In the Central Valley of California there is, in overdraft upon underground water due to over-extension of irrigation acreage, a shining example of water shortage. Here, the rehabilitation stems from the gigantic Shasta and Friant dams. Again, the nation cannot afford the cost of food so produced.

Theodore Roosevelt's statement that "it is . . . right for the national government to make the streams and rivers of the arid regions useful by engineering works for water storage . . .," is valid per se. But, unfortunately, transportation by improved river channels is more costly than by railway. The Missouri River with its Fort Peck extravaganza is an extreme example. River channel improvement is no warrant for much of the irrigation development under way or proposed.

The facts cited in the article constitute one of the reasons why the national debt has grown to staggering size—a situation most unfortunate in view of the necessity for the national defense program now under way. It is or should be a national scandal that while the government is spending enormous sums of money in enlargement of agricultural production it is paying farmers equally large sums to reduce that production.

On the other hand, the engineering department of the Bureau of Reclamation, which is not responsible for the reclamation policy of the Bureau, has, in the magnitude and technical soundness and excellence of its designs and constructions, written a shining page in the annals of irrigation engineering.

Oakland, Calif.
J. L. CAMPBELL, M. Am. Soc. C.E.

Proposed Standards for Land Description Studied

TO THE EDITOR: I was particularly interested in the paper by Professor Kissam on "Proposed Standards for Land Description," because it is somewhat along the line of work being carried on in this state by a committee of the Virginia Section of the Society. The Virginia records on land surveys are probably in as bad shape as anywhere in the country, because there has never been any control over the way surveys were conducted, or over the manner in which they were finally platted.

The committee to which I refer was appointed in February 1940, by the Virginia Section, to study the need for drawing up a set of specifications under which all land survey plats would be submitted. This committee has now completed its report, which unanimously recognized the need for such specifications. These are outlined, since any administrative body that may eventually be set up to carry them out would naturally attend to the details itself. The report has six recommendations dealing with: Survey Methods, Calculations, Plot of Survey, Plane Coordinates, Administration, and Legislation.

The committee was originally proposed in order to get some control over plats turned in for record. The first meeting, however, led to the belief that the recommendations should go further than this. If the final report is adopted by the Virginia Section, our next step will be to get favorable action by the legislature. If this comes about, all further property surveying will be carried out on a much higher plane than at present.

The recommendation regarding plane coordinates simply suggests that this method of designating points will be acceptable in descriptions. It provides an entering wedge for a later attempt to have the Virginia system of plane coordinates legally recognized by the legislature. Such a system is being laid out in the state as funds become available, but as yet no law has been adopted regarding its use.

The recommendation dealing with the plotting of surveys requires that the plot be a first-class engineering job which is capable of no misinterpretation. This latter is naturally desirable and essential, but in too many cases has not been carried out. Although our committee has made no attempt to specify how descriptions should be written, the requirement of a first-class plat to accompany any description should help solve the problem of poor descriptions.

T. H. EVANS, Assoc. M. Am. Soc. C.E.
Associate Professor of Civil Engineering, University of Virginia
Charlottesville, Va.

Describing Engineering Materials

DEAR SIR: In the November number there is an article entitled "Fitting Rolled Earth Dams to Local Materials," by B. K. Hough, Jr.

In Fig. 1, I note that the word "pervious" is written in (*b*) on both the inner and outer faces of the banks, and in (*c*) it appears on the outside of the banks.

This brings to my mind the fact that many years ago in the construction of the Upper Roxborough Reservoir in this city, similar layers were marked on the drawings "poorest material." It was, of course, intended that the poorest materials on the site should be placed in the designated part of the reservoir banks, and that the other and better materials should be placed in the core.

The reservoir leaked badly when it was first filled, and it was said that the contractor had conscientiously sought out all the poorest materials he could find in the vicinity and deposited them in the banks where the designation "poorest material" was written, so I would respectfully call attention to the fact that the word "pervious" is not the best kind of description.

SOLOMON M. SWAAB, M. Am. Soc. C.E.
Consulting Engineer
Philadelphia, Pa.

SOCIETY AFFAIRS

Official and Semi-Official

Plans for Eighty-Eighth Annual Meeting

Some Advance Information on Events for January 15–18, 1941, in New York City

Details of the program of the Eighty-Eighth Annual Meeting of the Society, to be held January 15–18, 1941, are rapidly being completed. Present indications point to a meeting of much interest to members and ladies alike. Although arrangements are being further perfected from day to day, advance news of the program can now be given out.

Business Meeting

Sessions will start on Wednesday morning, January 15, with the annual business meeting. As an important detail, the conferring of Honorary Memberships and the award of Society medals and prizes for papers will follow. The recipients of Honorary Membership in the Society will be Charles P. Berkey, George H. Fenkell, John D. Galloway, Frank G. Jonah, and Reginald H. Thomson. Notice of prize winners and of their papers in Transactions has already been given in a previous issue. It is expected that these men, together with the new Honorary Members, will be present in person to receive these fitting tributes to their engineering success.

A special event at this Annual Meeting will be the conferring of the John Fritz Medal on Ralph Budd, M. Am. Soc. C.E. This medal is not restricted to Society members and hence its award to a civil engineer is a matter of congratulation. The Society is proud to make this ceremony a feature of its Wednesday session.

After the formalities of introducing the President-elect and the new Vice-Presidents and Directors, the meeting will recess for luncheon on the fifth floor of the Engineering Societies Building. Immediately following, the afternoon general meeting and the Student Chapter Conference will convene. These gatherings also will be accommodated in the headquarters building.

Technical Programs

A day and a half have been reserved for the technical meetings. These have been scheduled as follows:

Wednesday afternoon—General Meeting and Student Chapter Conference
Thursday (all day)—Technical Division Sessions

The following Divisions have programs in preparation: City Planning, Highway, Power, Sanitary Engineering, Structural, and Waterways. Each has at least one session in prospect, some more than one. No joint sessions are contemplated.

Dates of Smoker and Dinner Dance Interchanged

Particular attention is called at this time to a change in the dates of the smoker and dinner dance. Circumstances have led to the assignment of the smoker to Wednesday evening, January 15. Conversely, the dinner dance is now set for Thursday evening, January 16, and the ballroom of the Hotel Waldorf-Astoria has been reserved for the gala event. The smoker will be held at the Manhattan Center; plans for this program contemplate an entertainment lasting about an hour, the rest of the evening being free for looking up friends and visiting. Light refreshments and smokes will be provided.

The Ladies' Committee is making plans to entertain the ladies at luncheon on Thursday, January 16, at the Biltmore Hotel, to be followed by a fashion show and tea in the afternoon.

Inspection Trips on Friday

Instead of the customary all-day Friday excursion, the committee is arranging a number of inspection trips to points of engineering interest. One or more of the excursions will be of particular appeal to the ladies.

On Saturday, the Sanitary Engineering Division, in cooperation with the New York State Sewage Works Association, will have an inspection trip to sanitary works in the vicinity.

Early Registration Desired

In view of the likelihood that the forthcoming meeting will attract a large number of members, early registration is urged. A summary of the program and a registration card will be mailed to the membership in order to enable members to order tickets for trips and social events in advance. As usual the final program of the Annual Meeting will be published in the January issue of Civil Engineering. Those who are enabled to make advance plans to combine a visit to New York City with the attractions of a Society meeting, with all the technical and social advantages which these connote, will be amply repaid.

Professional Records of Nominees

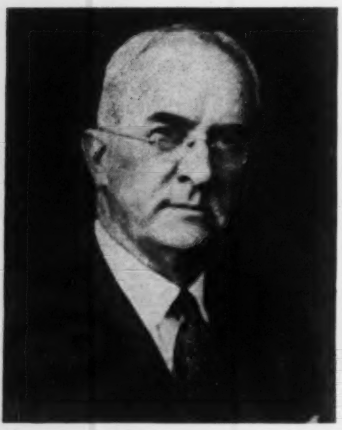
Brief Biographical Sketches of Candidates for Society Offices

Frederick H. Fowler

Frederick H. Fowler was born at Fort Custer, Mont., on March 30, 1879, and graduated from Stanford University in 1905, with the degree of A.B. He then became engineer in charge of construction of the California section of Laguna Dam on the Colorado River, near Yuma, Ariz., and in 1906 and 1907 was engineer on surveys for a proposed American River water supply for San Francisco. He then returned to his alma mater, where for a year he was instructor in civil engineering. In 1909 Mr. Fowler was engineer on topographic surveys in Michigan, and in 1910, engineer on sewer construction in California. Except for a period of war service as a captain with the 211th Engineers at Camp Meade, Md., he was for the next twelve years (1910 to 1922) hydroelectric engineer and district engineer for the U.S. Forest Service at San Francisco, and during the last two years of this period he served as engineering representative in California and Nevada of the Federal Power Commission.

Since 1922 Mr. Fowler has maintained an engineering practice in San Francisco. He has served as consultant to the Corps of Engineers, U.S. Army, on the design of dams on the Yuba, Bear, and American rivers; to the Federal Emergency Administration of Public Works; to the Flood Protection Planning Committee of Greater Kansas City; to the National Park Service; to the Los Angeles Department of Water and Power; and to other organizations. He was special consultant for the PWA on the Fort Peck, Grand Coulee, and Bonneville dams, and served on the Board of Review of the Altantic-Gulf Ship Canal. Mr. Fowler was also director of the National Drainage Basin Study (1936) and was a member of the Governor's Commission to Investigate Causes Leading to the Failure of St. Francis Dam, and of the California State Committee on Water Resources Investigation.

He was elected a Junior in the Society in 1906, Associate Member in 1911, and Member in 1924. He served as Director from 1928 to 1930, and has been a member of the Special Committee on Effect of Earthquakes, of the Special Committee on Flood Protection Data, of the Committee on Masonry Dams, and of the Executive



FREDERICK H. FOWLER
Nominee for President of the Society

Committee of the Engineering Economics Division. He was president of the San Francisco Section in 1939. From 1925 to 1931 he served as chairman of the San Francisco Advisory Committee of the Engineering Societies' Employment Service. His other affiliations include membership in the Society of American Military Engineers, the Seismological Society of America, the American Ornithologists Union, the California Academy of Sciences, and the Stanford Alumni Association (of which he is ex-president). He is a director of the Engineers' Club of San Francisco, and a member of the Cosmos and the Army and Navy Clubs of Washington, D.C.

During the past few years Mr. Fowler has made extensive studies of flood volumes in the Mississippi tributaries. He is the author, also, of various papers on power development, dam design, the Colorado River, and other subjects and, in 1923, published *Hydroelectric Power Systems of California*.

CHARLES H. STEVENS

CHARLES H. STEVENS was born in Harrisburg, Pa., on October 21, 1875. He was educated in the public schools of Harrisburg and later, after removal to Philadelphia, in evening technical schools and by home study. At the age of twelve he was indentured to Thomas Shaw, a noted mechanical engineer and inventor of Philadelphia, and served a nine-year apprenticeship at the machine trade. He was then employed for two years by the Reading Railway Company of Philadelphia as a draftsman on ship repairs and maintenance, and on construction plans for a grain elevator, several freight piers, and on general railroad maintenance work.

In August 1900 he entered the service of the City of Philadelphia as a draftsman in the Bureau of Surveys on plans for highway and railway bridges. In February 1903 he resigned from the city service to enter the employment of the Philadelphia Rapid Transit Company, where he was engaged for four years on the design of several sections of the Market Street subway and elevated railway. Upon the completion of this work he returned to the Bureau of Surveys as engineer in charge of planning the elevation of the tracks of the Reading Railway System to abolish a large number of grade crossings. This engagement continued until March 1913 when he became Superintendent of High Pressure Fire Service for a few months on a special assignment to clean up the work of several unfinished pipe-laying contracts.

In July 1913 the City of Philadelphia embarked on an extensive program of subway and elevated railway construction, and the Department of City Transit was organized to take charge of this work. Mr. Stevens was transferred to this department and placed in charge of the design and planning of the new system. In August 1930 he became chief engineer of the Transit Department and was the engineering executive in charge of transit construction until January 1940, when he retired to engage in private practice as an engineering consultant.

CHARLES H. STEVENS
Nominee for Vice-President, Zone II

For more than 37 years Mr. Stevens' work centered on the improvement of transportation facilities. During this period he was engaged on the planning, design, construction, and equipment for operation of the Market Street Subway and Elevated Railway, the Frankford Elevated Railway, the Broad Street Subway System, and the first section of the Market Street Subway extension under the Schuylkill River. The construction of the subways involved some difficult and interesting problems, such as the underpinning of City Hall, a massive masonry structure, to permit the construction of the Broad Street Subway under the building and, later, to provide for the extension of the Market Street Subway under the building and over the Broad Street Subway; and the construction of a section of the Market Street Subway under the Schuylkill River.

In 1914 Mr. Stevens became an Associate Member of the Society, and in 1920 a Member. From 1930 to 1932 he served as Director, representing District 4, and was a member of the Committee on Publications that brought out the first issue of CIVIL ENGINEERING. He has taken an active part in the work of the Philadelphia Section, and has been secretary-treasurer and president. He was a charter member of the Society of Municipal Engineers of Philadelphia, which he has served as secretary and president, and in 1925 he was awarded its medal for twenty years of meritorius service to the City of Philadelphia. Mr. Stevens is also a member of the Society for Testing Materials, and of the Engineers Club of Philadelphia, of which he has been director and is now vice-president.

CHARLES B. BURDICK

CHARLES B. BURDICK has been engaged in the general practice of hydraulic and sanitary engineering for cities and corporations for 45 years, beginning as an assistant to his present senior partner, and continuing with his present partners, all of whom have grown up in the same organization. His work has largely related to water supply, sewerage, the treatment of water and sewage, and flood-control works.

He graduated at the University of Illinois in 1895 (B.S.C.E.) in the course of municipal and sanitary engineering and received the degree of C.E. in 1912. Immediately following graduation he entered the office of John W. Alvord, Hon. M. Am. Soc. C.E., where for two years he was draftsman and assistant engineer. For the next five years he was in the employ of John A. Cole, C.E., who was president of several water companies, and under whom he planned and supervised improvements to numerous water works systems. During this engagement he became familiar with the business side of water supply.

In 1902 he renewed his association with Mr. Alvord, coming back as a partner, and for the next 21 years as Alvord and Burdick the firm carried on with increasing responsibilities. In 1923 the firm became Alvord, Burdick and Howson, under which name a large part of its work has been done.

CHARLES B. BURDICK
Nominee for Vice-President, Zone III

In his practice as an engineer, Mr. Burdick's work has taken him into nearly all the states under a wide variety of conditions relating to water supply, including the development and treatment of ground surface waters from perennial sources and impounded supplies. His work includes the preliminary plans and estimates for the supply of the nine cities on the east side of San Francisco Bay, since carried out by the East Bay Utility District, in which mountain water was impounded and carried across the San Joaquin Valley.

The treatment of water for purity and softness has engaged much of his attention during his entire practice, his more important works including the recently constructed plant for Milwaukee, large additions to the Louisville water works, and the treatment of the new west-slope water supply for Denver. The treatment plant for Miami, Fla., is one of the larger ground-water softening plants.

Another important aspect of Mr. Burdick's work has been the laying down of expansion programs for municipal water works and the rate structures to support them. In several cases these programs have been followed for many years, with continuing engagements in the construction of the works. The treatment of sewage has largely grown up during Mr. Burdick's practice as an engineer, and he was among the first to design such plants. Among his recently completed plants are those for protecting Lake Michigan water at Gary, Racine, and Kenosha.

During the World War Mr. Burdick was in charge of engineering operations for the Constructing Quartermaster at Camp Las Casas, San Juan, P.R., and of water, sewers, and roads at Camp Grant, Rockford, Ill. He is now in charge of similar work for a Midwestern cantonment.

He became an Associate Member of the Society in 1905 and a Member in 1911, and served as a Director from 1936 to 1939. He has been a member of several Society committees, serving as chairman of the Committee on Publications and, more recently, as chairman of the Special Committee on Flood Relief. He is a member of the American Water Works Association, the Western Society of Engineers (past-president), the Chicago Engineers Club (past-president), the University Club of Chicago, and several of the state engineering societies.

JOHN W. COWPER

JOHN W. COWPER was born at Suffold, Va., on April 27, 1871. In 1888, after six months in the city engineer's office at Chattanooga, Tenn., Mr. Cowper entered railroad work. From 1888 to 1893 he was, successively, chainman, rodman, draftsman, and assistant engineer for the Cincinnati, New Orleans and Texas Pacific Railway Company; from 1894 to 1895 resident engineer in charge of construction of ten miles of railway at Cleveland, Ohio, for what is now the Baltimore and Ohio; and from 1895 to 1901 with the Cleveland, Cincinnati, Chicago and St. Louis Railway Company—successively as section foreman and track supervisor, engineer of maintenance of way for the Cairo Division, and engineer of maintenance of way for the St. Louis Division. During this period he had charge of the upkeep of about 270 miles of main line.

JOHN W. COWPER
Nominee for Director,
District 3

In 1901 Mr. Cowper left railroad work to go with James Stewart and Company, Contractors, as superintendent and, later, manager of all work for that company in England. From 1901 to 1904 he was superintendent of construction on plant for the British Westinghouse Company at Manchester, England, and during this period was, also, superintendent of construction on electrification of the Mersey Railroad at Liverpool. In 1909 he became vice-president of the Worden-Allen Company, of Milwaukee, and the Lackawanna Bridge Company, of Buffalo, for which he was in charge of all construction work including many industrial plants.

He remained in this capacity until 1915, when he organized the John W. Cowper Company, Inc., engineering and contracting firm of Buffalo, N.Y. This firm, of which he is president and a director, has designed and constructed many large and important buildings, including the Buffalo plant of the National Aniline and Chemical Company, the Buffalo City Hall, mills for the Bethlehem Steel Company, and large projects for the U.S. Housing Authority.

Mr. Cowper was elected a Junior in the Society in 1894, Associate Member in 1901, Member in 1922, and Life Member in 1936. Since 1938 he has served as a member and chairman of the Construction Division of the Society. He is, also, a charter member and life member of the American Railway Engineering Association; life member of the Western Society of Engineers; and life member of the board of directors of the Associated General Contractors of America, of which he was one of the organizers and has since served as director and president.

GUSTAV J. REQUARDT

GUSTAV J. REQUARDT was born in Baltimore, Md., on November 11, 1886. He attended the Baltimore City College, and received the degree of civil engineer at Cornell University in 1909.

Immediately upon graduation, he entered the services of the former Baltimore Sewerage Commission, his experience ranging from the design of sewers and drains to design, construction, and operation of the sewage works at Back River. In 1914 and 1915 he was the representative of the city in an association with the U.S. Public Health Service in the conduct of pioneer experiments on the activated sludge process of sewage treatment. He was acting as division engineer in charge of the treatment works when the work of the Commission came to an end in December 1915.

GUSTAV J. REQUARDT
Nominee for Director,
District 5

In 1916 Mr. Requardt joined the engineering firm of Norton, Bird and Whitman, of Chicago and Baltimore, and was later made a partner. In 1925 the firm name was changed to Whitman, Requardt and Smith, and Mr. Requardt has been active in the organization to date. His personal work with the firm has been along the lines of sanitary and water supply engineering, valuation of properties, testimony, housing, and city planning, and at present he is in charge of its engineering work at Edgewood Arsenal for the federal government.

In 1917 and 1918 Mr. Requardt was engineer for the Maryland Dredging and Contracting Company, builders of the ordnance proving ground at Aberdeen, Md., and in 1924 he was assistant to two of the consulting engineers of the Engineering Board of Review for the City of Chicago, studying the question of the lowering of the Lake levels.

During the depression he took a leading part in providing financial assistance and finding work for unemployed engineers in Maryland, and is still a member of the standing committee formed at that time. For many years he has been an examiner for the City of Baltimore and the State of Maryland to determine the qualifications of men applying for civil service technical positions.

Since 1932 Mr. Requardt has been a member of the Board of Advisory Engineers to the City of Baltimore in making studies and plans for the future water supply of the city. He was also one of the consultants on the construction of the Montebello-Loch Raven Tunnel recently completed by the city. In 1939 he was appointed to an Advisory Board of Engineers for the City of Cleveland to study the matter of sewerage rates; in 1938 he was appointed consulting engineer to the Corps of Engineers, U.S. Army, on flood-control studies on the Susquehanna; and in 1940 he was appointed to a Board of Advisory Engineers to recommend master plans for the Baltimore City Planning Commission.

Mr. Requardt joined the Society as an Associate Member in 1914, becoming a Member in 1919. Long active in Society affairs, he was president of the Maryland Section in 1931 and has served on several of the Society's committees. He is a member and past-president of the Cornell Society of Engineers, a life member of the American Public Works Association, a delegate to the American Engineering Council, a member of the American Water Works Association, and past-president of the Engineers Club of Baltimore.

WILLIAM NELSON CAREY

WILLIAM NELSON CAREY was born in St. Paul, Minn., and educated at the college of civil engineering of the University of Minnesota, class of 1913. His early professional experience was on railroad survey and construction work in North Dakota, Washington, and Oregon, followed by river improvement work and reservoir and dam construction in Minnesota as a junior engineer in the War Department.

In 1917, Mr. Carey was commissioned as Captain of Engineers and assigned as regimental adjutant to the 313th Engineers, 88th Division, stationed at Des Moines, Iowa, during organization and training of his division. Early in 1918 he was promoted to the grade of major and given command of the 1st Battalion, 313th Engineers. He accompanied his division to France and commanded his battalion in action on the French front. When his division was relieved in the late summer of 1918, Mr. Carey was

WILLIAM N. CAREY
Nominee for Director, District 7

transferred and made Assistant Corps Engineer of the 7th Army Corps with which he served during the Meuse-Argonne offensive and in the Army of Occupation in Germany. His principal duty with the 7th Corps covered military roads. He was honorably discharged from the army in June 1919, with the grade of Major of Engineers. In 1922 he accepted a commission in the Corps of Engineers, Reserve, with the same grade and, at present, holds the rank of Colonel.

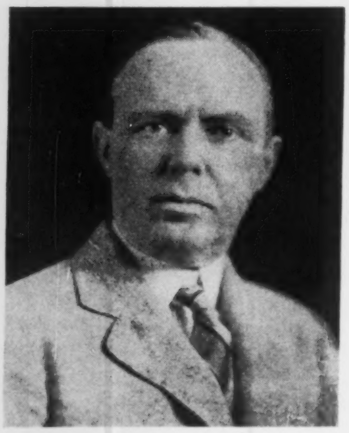
After leaving active army service in 1919, Mr. Carey became a member of a firm of consulting engineers and architects, having charge of the municipal and hydraulic work of the firm until 1923. From 1923 to 1933 he served the City of St. Paul, first as assistant city engineer and then as city engineer during an extensive civic improvement program that included the design and construction of trunk sewers and tunnels, street improvements, bridges, and viaducts involving an expenditure of about $30,000,000. In 1933, Mr. Carey was appointed state engineer for Minnesota for the Public Works Administration then being organized, and he headed the PWA office in Minnesota until 1936 when he was placed in charge for this organization of the design and construction of the Minneapolis-St. Paul Sanitary District work, a trunk sewer and treatment plant project costing $17,000,000. Upon completion of this work late in 1938, Mr. Carey opened an office in St. Paul and has since maintained a general consulting practice.

He joined the Society as an Associate Member in 1916, becoming a Member in 1919. In 1936 he was appointed a member of the Executive Committee of the Highway Division and at present is chairman of this committee and of the Society's Committee on Military Road Construction and Maintenance. He has also served as president of the Northwestern Section. He is a member of the Minnesota Association of Professional Engineers, the Central States Sewage Works Association, the Society of American Military Engineers, and the American Road Builders' Association, and is a former president of the Minnesota Federation of Architectural and Engineering Society. Mr. Carey was an active proponent in the passage of the engineering registration law in Minnesota and is a registered civil engineer in that state.

GEORGE B. MASSEY

GEORGE B. MASSEY was born in Cleveland, Ohio, on May 7, 1875, and was reared in Watertown, N.Y. He graduated from the Sheffield Scientific School of Yale University, with the degree of bachelor of science, in 1895.

After graduation, he spent three years on the Mexican International Railway, resigning at the outset of the Spanish-American War. He obtained a commission as assistant engineer in the U.S. Navy and took part in several bombardments off Cuba and in the naval battle off Santiago on July 3, 1898, when Cervera's fleet was destroyed. He also served in and about Manila during the Philippine insurrection.



GEORGE B. MASSEY
Nominee for Director, District 8

In June 1917, Mr. Massey was given a commission as lieutenant, jg, in the U.S. Navy, and spent over a year in mine-laying in the North Sea. He was retired with the rank of lieutenant in February 1919.

His consultation work in this country has included the Miami Conservancy District, the Florida Cross-State Canal, the proposed Lake Erie and Michigan Canal, improvement of the Arkansas River, land reclamation in New Orleans, and recovery of low-grade minerals, especially coal and phosphate, by stripping and open-cut mining and by dredging. His work in connection with excavation problems has taken him repeatedly to all parts of Europe, including Russia, and also to India, Burma, Siam, the Straits Settlements, China, Panama, Cuba, and Alaska. He has been vice-president of the Randolph Perkins Company, Engineers, since 1921.

Mr. Massey joined the Society as a Member in 1916. He served as secretary of the Illinois Section for six years and is now vice-president of the Section. He has also served as a member of the Society's committee reporting on "Construction Plant and Methods for Flood Control on the Lower Mississippi and Similar Streams" (Manual 12) and of a subcommittee preparing data for Manual 4. He is a trustee of the Western Society of Engineers, a past-chairman of the Consulting Engineering Division of that organization, and past-chairman of its Hydraulic, Sanitary and Municipal Section.

He is the author of *Engineering of Excavation*, and has contributed articles to several publications in this country and abroad, to the Standard Handbook for Electrical Engineers, and to the Encyclopaedia Britannica.

RALPH B. WILEY

RALPH B. WILEY was born in Detroit, Mich., on March 5, 1884. He received the degree of bachelor of science in civil engineering from the University of Michigan in June 1906. Immediately following his graduation he taught strength and resistance of materials in the university summer session.

From September 1906 to September 1908 he was employed on "The Improved Water and Sewage Works" of Columbus, Ohio, under the late John H. Gregory, M. Am. Soc. C.E. In September 1908 he was appointed instructor in hydraulics at Purdue University, and he has served Purdue continuously since that time—as assistant and then associate professor of hydraulic engineering, associate professor of sanitary engineering, and professor of sanitary engineering; as acting head of the school of civil engineering for three years; and since June 1937 as professor of civil engineering, head of the school of civil engineering, and director of the materials testing laboratory. Since December 1938 Professor Wiley has also been director of the Joint Highway Research Project, which is carried on through a cooperative agreement between the State Highway Commission of Indiana and the Purdue Engineering Experiment Station, under which the Highway Commission furnishes $50,000 a year for highway research. He is, also, state engineer of Indiana.

RALPH B. WILEY
Nominee for Director,
District 9

His primary interest, however, has been civil engineering education, and he has served on numerous faculty committees and has long been active in the development of Purdue University as an engineering school. He was the Society's representative on the E.C.P.D. inspection committee investigating Midwest universities for accrediting. He has also been a member and for two years was chairman of the Society's Committee on Student Chapters.

Practically all his summers have been spent in engineering work, such as flood studies for the Indiana Flood Commission, sewage treatment with Greeley and Hansen, reports on water or sewage for Indiana cities, and sewerage studies for Detroit, Mich. He prepared the hydraulic studies and plans for the Connors Creek Sewer at Detroit as it was finally built, and for sixteen summers was consultant for the City of Detroit.

Besides his affiliation with the Society (he joined as a Junior in 1908 and became an Associate Member in 1916 and a Member in 1922), Professor Wiley is a member of Sigma Xi, Tau Beta Pi, Scabbard and Blade, Chi Epsilon, the American Public Health Association, the American Association of University Professors, and the Central States Sewage Works Association. He is also a member of the John M. Goodell Prize Committee of the American Water Works Association and of the Council of the Society for the Promotion of Engineering Education.

JOHN W. CUNNINGHAM

JOHN W. CUNNINGHAM was born in Watertown, S.D., on March 21, 1887, and was graduated from the University of Wisconsin in 1908, receiving the degree of bachelor of science in civil engineering.

His first professional work was as assistant to Prof. Leonard S. Smith at Madison, Wis., whom he assisted with his private practice. In 1909 he went to Spokane, Wash., where for three years he was a draftsman for the North Coast Railroad Company and the Oregon-Washington Railroad and Navigation Company on the structural design of heavy railroad bridges. In 1912 and 1913 Mr. Cunningham was assistant engineer in charge of design for the Kittitas Reclamation District at Ellensburg, Wash. (now the Kittitas Project of the U.S. Bureau of Reclamation). In 1913 he moved to Portland, Ore., as draftsman for the Northwest Steel Company, later having charge of the design and construction of a new structural fabricating plant for that concern.

JOHN W. CUNNINGHAM
Nominee for Director,
District 12

In 1915 he became associated with Joseph O. Baar, in private engineering practice at Portland, Ore., under the firm name of Baar and Cunningham. This partnership existed until 1937, when Mr. Baar retired, and since that time the organization has continued with the title of John W. Cunningham and Associates. The private practice of the partnership, originally in the structural engineering field, has subsequently developed along general civil and hydraulic engineering lines. In the 1917–1925 era of reclamation improvement in the Northwest, the firm handled a number of large irrigation, drainage, and diking projects. More recently its clients have been mainly municipalities, and its work has been on the design and construction of water works and sewerage improvements. Among other projects, it planned and constructed major units of the 100-mgd industrial water systems for Everett and Bellingham, Wash.

Long active in engineering societies, Mr. Cunningham has served in various offices, including that of president of the Oregon Society of Engineers, of the Oregon chapter of the American Association of Engineers, and of the Oregon Section of the American Society of Civil Engineers. He became a Junior in the Society in 1909, Associate Member in 1914, and Member in 1925. One of his principal activities has been concerned with the registration of engineers, and he is a member of the Oregon State Board of Engineering Examiners. He is also a member of the Portland City Planning Commission and of the Oregon Economic Council, which is the present state-planning authority for Oregon.

ERNEST E. HOWARD

ERNEST E. HOWARD was born and lived his early years in Toronto, Canada. He graduated from the University of Texas in 1900, receiving the degrees of civil engineer and bachelor of science. In 1939 the University of Nebraska gave him the honorary degree of doctor of engineering. In 1901, after a brief term as instructor in engineering at the University of Texas, he joined the staff of Waddell and Hedrick, consulting engineers, specializing in the design of bridges and similar structures. Since that date he has been continuously engaged in private consulting engineering practice in this field of work, with new firms growing out of the old.

ERNEST E. HOWARD
Nominee for Director,
District 16

His early work was drafting, inspection, design, and supervision of construction—in 1903 and 1904 as resident on the firm's extensive bridge program in Mexico, and in 1905 and 1906 as resident engineer on the Intercity Viaduct in Kansas City. In 1907 he was given an interest in the reorganized firm, and in 1914 joined in organizing the firm, Harrington, Howard and Ash and, with its dissolution in 1928, in organizing the present firm of Ash-Howard-Needles and Tammen, with offices in Kansas City, Missouri, and New York.

With his partners and associates, Mr. Howard has thus been responsible for the design and construction of bridges and similar structures in 36 states and several foreign countries, comprising more than 500 different projects. The foreign work of the firm includes 30 bridges in Canada, several in Manchuria, two in Russia, and many in Mexico. Mr. Howard also participated in an advisory and consulting capacity on the construction of the Detroit-Superior Viaduct, the Pulaski Skyway, Sibley Bridge, and other important structures. He has played an active part in the development of the vertical-lift bridge, and has been responsible for innovations in mechanical features for movable bridges and in foundation construction.

In 1918 Mr. Howard was commissioned Captain of Engineers and served at Fort Benjamin Harrison.

His researches in ancient engineering construction have led to a lively interest in archaeology, and he was for several years president of the Kansas City chapter of the Archaeological Institute of America. Since 1930 he has been chairman of the Board of Trustees of the University of Kansas City, of which he was one of the founders.

He is the author of one book; of three papers in TRANSACTIONS, for one of which he was awarded the Thomas Fitch Rowland Prize in 1921; and of numerous other articles in technical and general publications. He has also made many addresses before various engineering colleges.

He was elected a Junior in the Society in 1901, Associate Member in 1905, Member in 1913, and Life Member in 1940. He has served as president of the Kansas City Section, was for several years on the Society's local membership committee, and at present is a member of the Committee on Fees. Mr. Howard's other affiliations include membership in the American Institute of Consulting Engineers, the International Association for Bridge and Structural Engineering, the American Society of Mechanical Engineers, the Missouri Society of Professional Engineers, the Engineers Club of Kansas City, Phi Beta Kappa, and Tau Beta Pi.

Meeting of the Board of Direction—Secretary's Abstract, October 14–15, 1940

ON OCTOBER 14 and 15, 1940, the Board of Direction met at the Hotel Netherland Plaza in Cincinnati, Ohio, with President John P. Hogan in the chair, and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Riggs and Sawyer; Vice-Presidents Ferebee, Davis, Jacobs, and Lucas; and Directors Agg, Anderson, Ayres, Blair, Bres, Brooks, DeBerard, Dunnells, Goodrich, Harrington, Hudson, Hyde, Leeds, Lewis, Parker, Polk, Root, Sawin, and White.

It was noted that every one of the 26 members of the Board was present, answering to the first roll call. The meeting continued for two days with two sessions each day.

Approval of Minutes

Minutes of the Board of Direction meetings for July 22–23, 1940, and of the Executive Committee for July 21, 1940, were approved.

Announcement of Nominee for President—Frederick Hall Fowler

The Nominating Committee reported to the Board that following regular procedure Frederick Hall Fowler, M. Am. Soc. C.E., had been duly nominated for President of the Society for 1941; and that he had accepted the nomination.

Proposed Standards Approved

Two activities under the routine of the American Standards Association were presented, relating to "Manhole Frames and Covers" and to "Abbreviations of Scientific and Engineering Terms." Following the recommendations of the Society representatives, the Board approved the proposals for official transmission to the Association.

Prize Awards for 1940 Confirmed

Acting on the recommendation of the Committee on Prizes, the Board approved Society awards. Similar recommendations from the respective committees were followed in the case of Division and other awards, including the Construction Engineering Prize, the Rudolph Hering Medal, and the Daniel W. Mead Prizes. Details of these various honors were given in the November issue.

Division Executive Committees

Nominations for new appointments to the executive committees of the various Technical Divisions were confirmed. The new nominees were noted in the November issue of CIVIL ENGINEERING.

Multiple-Purpose Water Projects

It was recommended to the Engineering Economics Division that it appoint a committee on proper allocation of costs of multiple-purpose water projects, for study and report.

New Honorary Members

As a result of a canvass of ballots the election of five new Honorary Members was announced as follows: C. P. Berkey of New York, G. H. Fenkell of Detroit, J. D. Galloway of San Francisco, F. G. Jonah of St. Louis, and R. H. Thomson of Seattle. Brief details are to be found in another item in this issue.

J. Waldo Smith Hydraulic Fellowship

Following the report of the committee having this matter in hand, the award of the J. Waldo Smith Hydraulic Fellowship to the University of Iowa and to James Mueller Robertson, Jun. Am. Soc. C.E., was approved. This also was announced in the November issue.

Concessions for Those Enlisted in Military Service

In recognition of the handicaps under which enlisted men may be placed in maintaining Society membership, the Board adopted the following policy:

"RESOLVED: That members of the Society training or serving the country in the armed forces of the nation during the present limited emergency will be eligible for exemptions from dues under the following conditions:

"(1) Only enlisted Selectees, by operation of the Selective Service Act, and enlisted personnel of the Regular Army, the National Guard, and the Navy, shall be eligible.

"(2) Those holding commissions shall not be eligible except as they may apply for exemption which may be granted by action of the Executive Committee of the Society.

"(3) The period of exemption shall be limited to the period of national service.

"(4) In case of change of status, as by commissioned promotion, the conditions of exemption shall be modified accordingly.

"(5) Exemption shall be granted only on application on form to be prescribed."

American Engineering Council

Upon request, A. J. Hammond, Past-President of the Society and current President of American Engineering Council, addressed the Board, supplemented by similar presentation from A. A. Potter, Past-President of Council and of the American Society of Mechanical Engineers, both urging that the Board rescind its former action of withdrawing from American Engineering Council at the end of 1940. As a result of subsequent discussion, the prior action of withdrawal was left unchanged but a conference committee was authorized for discussion of the matter with the other Founder Societies and report back to the Board.

Ethics Paper as a Manual

Acting on the recommendation of its Publications Committee, the Board decided to issue the paper by D. W. Mead entitled "Standards of Professional Relations and Conduct," without discussion, as one of the series of official Society manuals.

Flood Studies

In view of the reports received from the Committee on Flood Protection Data and the Committee on Floods, the Board acceded to their requests that they be discharged. It was also voted that a new Committee on Floods be constituted within the Hydraulics Division, which committee is to continue study of flood protection data and to determine principles of practicable application of such data to the design and operation of flood control works.

Society's Student Chapters

On recommendation of the Committee on Student Chapters and in collaboration with the institutions concerned the Board authorized that

(1) Chapters at Pennsylvania Military College and at Antioch College be disbanded;

(2) The Chapters at Lewis Institute and at Armour Institute of Technology be merged into one at Illinois Institute of Technology, which action agrees with the corresponding merger of the institutions concerned; and

(3) The President be authorized to send "letters of commendation" to 12 Student Chapters of the Society for meritorious work during the year 1939–1940.

Notation of the Chapters accorded the latter honor were given in the November number.

Kansas Section

To avoid confusion, the Kansas State Section has voted its preference for the name, "Kansas Section." The Board approved.

Professional Conduct

A number of cases involving charges of violation of the Society's Code of Ethics were presented. After full discussion, action was taken in each instance in the light of the best interests of the profession.

Proposed Railroad Division

Petition signed by 23 members for the formation of a "Railroad Division" to discuss the economic relation of railroads to other modes of transportation received the careful consideration of the Board. While favoring encouragement to those interested in the technical problems of railways the Board concluded that the project is properly one to be developed within the Engineering Economics Division.

National Defense Construction Program

Report from Field Secretary Jessup as to his activities at Washington in connection with the National Defense Construction Program as authorized by the Board at its July meeting, received careful attention, particularly in relation to the proposed definition of the respective functions of civil engineers, architects, and landscape architects in relation to the Defense Housing Projects.

Transfer of Juniors to Associate Member Grade

Upon the recommendation of the Executive Committee, the Board adopted certain concessions (also referred to on a succeeding page) concerning the transfer of Juniors to the Associate Member grade, in the form of the following resolution:

"RESOLVED: That until revocation, the Secretary is hereby authorized, for Juniors transferring to Associate Membership, to accept payment of their dues pro-rated, for the year of transfer, on the basis of the month following that month in which their election by transfer takes place and to accept the dues so pro-rated and the difference between the entrance fees of the two grades in not more than three installments within the six months following transfer, or as that period may be extended for special reasons."

Routine Matters

Various communications, reports of Society committees, questions of admission and of transfer of membership, and other items were presented. In all cases, action corresponded with the judgment of the Board after full discussion.

Adjournment

The Board adjourned to meet at Society Headquarters on January 13, 1941.

United Engineering Trustees Elects Officers

AT ITS annual meeting on October 24, United Engineering Trustees, Inc., elected officers for the ensuing year. Harry A. Lardner, president of the J. G. White Engineering Corporation, was re-elected president. Other officers are J. P. H. Perry, M. Am. Soc. C.E., and Albert Roberts, vice-presidents; Walter Kidde, treasurer; W. D. B. Motter, Jr., assistant treasurer; and John H. R. Arms, secretary and general manager.

Professional Development Makes Progress

Activities Reported at Annual Meeting of E.C.P.D.

AT THE 1940 annual meeting of the Engineers' Council for Professional Development (E.C.P.D.) held on October 24 at the University Club, Pittsburgh, Pa., R. E. Doherty, president of Carnegie Institute of Technology, was elected chairman and Harry T. Woolson, executive engineer of the Chrysler Corporation, was elected vice-chairman. George T. Seabury, secretary of the American Society of Civil Engineers, becomes the E.C.P.D. secretary and H. H. Henline, secretary of the American Institute of Electrical Engineers, is assistant secretary. The other officers elected at the Pittsburgh meeting are A. A. Potter, past-president of the American Society of Mechanical Engineers, chairman of the Committee on Engineering Schools; Charles F. Scott, past-president of the American Institute of Electrical Engineers, the Society for the Promotion of Engineering Education (S.P.E.E.), and the National Council of State Boards of Engineering Examiners, chairman of the Committee on Professional Recognition; R. L. Sackett, M. Am. Soc. C.E., past-president, S.P.E.E., chairman of the Committee on Student Selection and Guidance; S. D. Kirkpatrick, editor of *Chemical and Metallurgical Engineering*, chairman of the Committee on Professional Training; and E. R. Needles, M. Am. Soc. C.E., of Ash-Howard-Needles and Tammen, New York, N.Y., chairman of the Ways and Means Committee.

ENGINEERING INSTITUTE OF CANADA BECOMES MEMBER

By unanimous vote of the Council, the Engineering Institute of Canada became the eighth participating body of E.C.P.D. A delegation of members of the Institute, headed by J. B. Challies, its past-president, was present. Dr. Challies, speaking on behalf of the president of the Institute, expressed its appreciation of the action by which it had become more closely affiliated with engineering bodies in the United States and announced the names of its representatives: J. M. R. Fairbairn, A. Surveyer, and J. B. Challies, all Members Am. Soc. C.E., and past-presidents of the Institute. He also introduced the other members of the delegation, C. R. Young, M. Am. Soc. C.E., professor at the University of Toronto, who was appointed to the Committee on Professional Training; H. F. Bennett, who becomes a member of the Committee on Student Selection and Guidance; and L. Austin Wright, general secretary of the Institute. James A. Vance, who was not present, will serve on the Committee on Professional Recognition.

REPORTS STATUS OF ACCREDITING

For the Committee on Engineering Schools, whose principal function has been the accrediting of curricula, Dean Potter reported as chairman. Incident to its accrediting program the committee has given advice informally to schools requesting it. As of October 20, 1939, curricula to the number of 433 had been accredited unconditionally, 82 for a limited period, and 172 had not been accredited. During 1939–1940 visits were made to 22 institutions for the purpose of reinspecting 70 curricula on the accredited list, and 17 institutions were visited in order to appraise 32 curricula not on the accredited list. As a result of the year's work and of actions taken on October 24, 1940, the record now stands as follows: Total curricula submitted, including reinspections, 791; accredited unprovisionally, 457; accredited provisionally, 83; not accredited, 164; reinspections resulting in no change in status, 82; action pending, 5.

STUDENT SELECTION AND GUIDANCE

Reporting for his Committee on Student Selection and Guidance, Chairman Sackett recommended:

1. In order to organize guidance in cities of 10,000 or more population, it is desirable that additional appeal be made to local interests. The effectiveness of guidance in the Metropolitan area, in Detroit, Milwaukee, Denver, Chicago, Omaha, and other cities, is due to the initiative of some person or small group. Appeal through the societies has had its effect but still we need other lines of communications.

The committee request that the E.C.P.D. approve the appointment of a subcommittee of the Committee on Student Selection and Guidance on "High School Organization."

2. "Engineering as a Career" is presented for your approval. It has been scrutinized by each affiliated society.

The committee requests that provision be made for its publication. For this purpose $4,000 will be needed if it is to be illustrated and printed in attractive, durable form.

3. It is possible that financial provision may be made for a study (*a*) of tests and examinations which have proved to be most effective in the selection of students who are better equipped to achieve in college and in life, and (*b*) of devices designed to differentiate between engineering ability and non-engineering talent.

The Council authorized publication of the guidance booklet, "Engineering as a Career," subject to the review of the manuscript by the Committee on Information and the availability of the necessary funds.

EFFORTS IN PROFESSIONAL TRAINING

The report of the Committee on Professional Training was presented by Dean O. W. Eshbach. In particular he stressed the progress made by local sections in their post-college student guidance, as indicated by returns from a questionnaire. The idea of having sections endeavor to give educational work directly had not been popular, he reported. In large metropolitan sections, however, the forming of groups of engineers within the section worked well. At the other extreme is the section of wide extent but relatively small membership, which probably could best confine its efforts to inducing junior engineers to attend and participate in the regular meetings.

Inspection trips, he remarked, are welcomed by junior engineers; yet they find it difficult to get away from the job. One of the best methods, it was found, was to have a senior engineer sponsor the younger man, not only in his personal contacts at meetings but as his general counselor. There is no doubt, he concluded, that sections are more active in this work of developing young engineers and more conscious of their obligations and opportunities.

PROFESSIONAL RECOGNITION

Still another important committee, that on Professional Recognition, stressed some special needs, as developed by the year's work. As chairman of this com-

Forecast for December "Proceedings"

FORT PECK SLIDE

By T. A. Middlebrooks, Assoc. M. Am. Soc. C.E.

Tests and analyses conducted on the soils and rocks encountered at this dam in Montana that have a bearing on the slide that occurred on September 22, 1938.

PLASTIC THEORY OF REINFORCED CONCRETE DESIGN

By Charles S. Whitney, M. Am. Soc. C.E.

The author states that the plastic theory takes into account the plasticity of the material and is in itself sufficiently "plastic" to be adjusted empirically to actual conditions.

REACTION OF CEMENT AND AGGREGATE IN EXPANSION OF CONCRETE

By Thomas E. Stanton, Jr., M. Am. Soc. C.E.

Excessive expansion of concrete may occur through chemical reactions between cements of relatively high alkali content and certain mineral constituents in some aggregates.

ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES BY SUCCESSIVE APPROXIMATIONS

By O. T. Voodhigula, Jun. Am. Soc. C.E.

A simplification of the classical method, involving a physical concept whereby an analysis may be made rapidly by successive approximations.

mittee, Dr. Scott made the following recommendations:

1. E.C.P.D. should urge upon its participating societies a study of the engineering profession, including its present status and proposals for its development. (It is suggested that this may include papers, discussions, reports, sponsored by the societies individually or in collaboration.)

2. E.C.P.D. should urge upon its participating societies that their student groups be encouraged to become informed and interested in a study of engineering as a profession, including its present status and its development; also the field of professional ethics. (It is suggested that studies similar to that of the American Society of Mechanical Engineers may be serviceable.)

3. E.C.P.D. should urge that the Society for the Promotion of Engineering Education interest its members in seeing that engineering students become acquainted with professional ethics, organization, and registration.

4. E.C.P.D. should urge state registration boards through the National Council of State Boards of Engineering Examiners to increase the present emphasis on character, social motivation, and understanding and practice of professional ethics in qualifying candidates for registration.

One of the outstanding features of this annual meeting was the annual dinner at the University Club, the same evening. Under the direction of Chairman Doherty, a number of splendid addresses were delivered by Dean Potter, by Mr. Kirkpatrick, by Prof. Young, by E. B. Roberts of the Westinghouse Electric and Manufacturing Company, and by Chancellor John G. Bowman of the University of Pittsburgh. This fine series of addresses brought to a fitting close a most worthwhile annual meeting of the Council.

Ralph Budd to Receive John Fritz Medal

SOMETIMES referred to as the highest award of the engineering profession, the John Fritz Medal is devoted to the recognition of distinguished contributions in the field of applied science. This year Ralph Budd has been selected as its recipient, primarily because of his dominant share in "the improvement of railroad tracks and service, especially the introduction of the lightweight streamlined train."

Engaged in various phases of railway engineering and administration since 1899, Ralph Budd was a leading figure in the reconstruction of the Panama Railroad in 1906–1909, the electrification and relocation of the Great Northern over the Cascade Mountains, completed in 1929, and the rehabilitation and nationalization of Russian railroads in 1930. He was President of the Great Northern Railway from 1919 to 1932 and has been President of the Chicago, Burlington, and Quincy Railroad since that time. He is also a director of the First National Bank of Chicago and of the International Harvester Company.

The Board of Award is composed of 16 representatives of the four Founder Societies. Daniel W. Mead, George S. Davison, Henry E. Riggs, and Donald M. Sawyer are the members of the Board delegated by the American Society of Civil Engineers.

Appointments of Society Representatives

E. B. BLACK, J. H. PORTER, EDGAR D. GILMAN, W. W. ZASS, and T. R. AGG, Members Am. Soc. C.E., have been appointed to the Executive Committee of the Engineering Economics Division for terms of two years, three years, four years, five years, and one year, respectively. Mr. Black is chairman, and Mr. Porter secretary.

DEAN G. EDWARDS, GLENN L. PARKER, and CHARLES SHAUGHNESSY, Members Am. Soc. C.E., and THOMAS PATRICK QUILTY, Jun. Am. Soc. C.E., have been appointed the Society's representatives to the National Conference on Engineering Positions.

J. L. EDWARDS, H. W. HANLY, and C. A. WILLSON, Members Am. Soc. C.E., have been appointed additional Society representatives on the Building Code Requirements for Iron and Steel.

EUGENE L. MACDONALD, M. Am. Soc. C.E., has been reappointed the Society's representative on the Council of the American Standards Association for the three-year term, January 1941 to January 1944. R. P. MILLER, M. Am. Soc. C.E., is alternate.

Membership Shows Healthy Trend

DURING the past twelve months Society membership has shown a net increase of 627 members, counting all categories and circumstances. For the comparable twelve months that came to an end November 14, 1939, the net membership increase was only 181.

An interesting feature of the increase is that it cannot be attributed to any abnormally large graduating class as might at first be supposed from a glance at the chart (Fig. 1), showing the seasonal accumulation of applications for admission. Further inspection shows that the line for 1939–1940 was more than 100 higher than the line for 1938–1939, prior to the first of June when the applications from graduates began to come in, and at the same slope, would have been about 150 higher early in September without the seasonal influx of Juniors. This September to September chart has been adopted for study purposes, that successive annual situations may be observed more clearly. Note the marked improvement over the depression years 1932–1933.

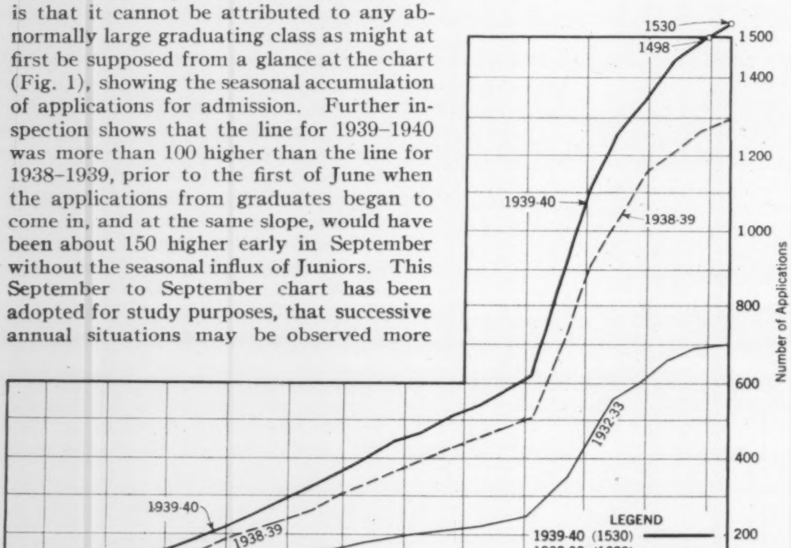


FIG. 1. APPLICATIONS FOR ADMISSION ACCEPTED AND READY FOR PUBLICATION

During the twelve months, December 1939 through November 1940, there have been received, and processed for action by the Board of Direction, 1,522 applications for admission, including 39 from outside the continental United States. Of this total 181 were for admission to the grade of Member, 272 to the grade of Associate Member, 194 to Junior membership by regular application, and 875 to Junior membership on the basis of the college degree. Approximately 350 applications for transfer also have been received and prepared for the Board's consideration.

Honors go to the states of Arkansas and North Dakota, with Nebraska a close third, for the highest ratio of admission applications (not counting "degree" Juniors) during the period, to the total membership, as of February 1, 1940. Arkansas' percentage of increase over previous membership is 12.3, with North Dakota's and Nebraska's applications amounting to increases of 10.8% and 10.7%, respectively. Next is Michigan with 10.0%, then Maryland with 9.6%. Of the ten states with the highest percentages, seven are west of the Mississippi, two are on the Atlantic Coast. The other is Michigan.

For the Society as a whole, the applications for the period are 4.0% of the February 1 membership. This 4.0% applies also to applications from outside the continental United States. New York, Pennsylvania, and California had the greatest actual numbers of applications—67, 58, and 49, respectively. Their combined percentage of increase, however, is only 3.05. Including degree Juniors, 1,522 applications for admission in a twelve-month period would indicate a 9.4% increase in membership were it not for deaths, the relatively few resignations, and those who must be dropped for non-payment of dues.

Positions and Salaries Analyzed for Nevada Highway Department

A NOTABLE service to the profession has been achieved by the Society in its report to the State of Nevada on engineering positions and salaries in the State Highway Department. Furnished in response to a request by the Highway Board of Directors, the survey, prepared by Allen P. Richmond, M. Am. Soc. C.E., Assistant to the Society, was presented on October 17. It contains recommended grade specifications and salary ranges, and urges the adoption of a merit rating system.

For some time the Nevada Highway Board of Directors has felt that a readjustment of the ratings and classifications in the department was desirable and for this reason authorized the study. Robert Allen, state highway engineer, arranged for the survey. The state cooperated fully and provided funds to cover expenses. The Society contributed Mr. Richmond's time, which included a residence of five and a half weeks in Carson City.

Thomas E. Stanton, former Director of the Society from Sacramento, was the official representative of the Society appointed by President Hogan. Mr. Stanton supervised all details of the study and assisted in the presentation of the report.

The Nevada report is similar in many respects to the one made last spring for the Arizona Highway Department. The number of engineering employees in the two states is almost the same (about 210), and highway work in Arizona has much in common with that in Nevada.

The report recommends six professional and four subprofessional grades, the professional grades matching the corresponding grades in federal, California state, Arizona state, and several other highway systems.

Recommended salary ranges correspond closely to those in California, the federal service, and Arizona. The state highway engineer is allocated to Grade 6, for which the minimum recommended salary is $6,500, the Highway Board to be authorized to name any higher salary within the range for Grade 6. Since the present Highway Act limits the state highway engineer's salary to $5,000, an amendment will be necessary to make this recommendation operative, and the Highway Board was urged to take the necessary steps to secure this amendment.

On the other hand, establishment of the recommended salary ranges for the other grades is within the present power of the State Highway Board, irrespective of the salary of the state highway engineer. It was recommended that the board put into effect without delay the new salary ranges in so far as they are not inconsistent with the present law.

The Nevada Highway Department had already made considerable progress toward the adoption of a merit system for engineering employees. The report urges that the state highway engineer install a suitable merit system at once.

The data featured in the report are all of western origin, highway officials in many far western states contributing the information. The Nevada Highway Department furnished all stenographic, clerical, and drafting aid, and has published the report in mimeographed form.

An important element in the survey was its sponsorship by the Sacramento Section, which has jurisdiction over the western half of Nevada. All details were cleared through the officers of this Section and through the Society's official representative, Mr. Stanton.

The Nevada Highway Board of Directors consists of the governor, the attorney general, and the state controller, all serving exofficio. Presentation of the report was made to the Highway Board on October 17. Many questions were asked, and details were thoroughly discussed. The board received the report and took it under consideration.

Civil Engineering Cuts to Be Destroyed

FOLLOWING its usual custom the Society will destroy cuts from Volume 9 of CIVIL ENGINEERING—that is, 1939—at the end of the current year. Those wishing to have any of these illustrations (cuts for the covers and pages of special interest are available only as a loan) should notify Society Headquarters before December 31, 1940. The only charge will be cost of forwarding by express or parcel post. Except for the fact that preference will be given to the authors of the articles in which the illustrations appear, requests will be filled in the order received.

Military Roads in Forward Areas Covered in Committee Report

"MILITARY Roads in Forward Areas," a partial report released by a special committee on Military Road Construction and Maintenance appointed by the Highway Division, has been in preparation for nearly a year. Designed to provide factual information for the use of military engineers as well as for the assistance of civilian engineers who may find themselves involved in closely associated activities, the report presents concise information on (1) equipment and methods suitable for rapid maintenance and improvement of roads in forward areas, (2) modifications of commercial methods and equipment for surfacing roads with bituminous or similar materials, and (3) sectional or other emergency types.

The study was based upon the doctrine that the military road problem in forward areas is principally one of re-construction and maintenance rather than of new construction. In order that it might be easily adaptable to use by the Army, it sets up standardized terminology with elementary definitions and descriptions of materials and methods. It contains a large number of tables covering quantities of materials required for road construction and maintenance. In fact, the report is intended to provide a simple textbook on roads for use by military engineers and was transmitted to the Chief of Engineers by the Secretary of the Society on November 6.

The report covers two main divisions, and to date contains ten sections. The first main division of the report deals with "Definitions and Road Construction" and the second with "Maintenance, Repair and Improvement of Roads." In Section 1, which covers "Definitions and Materials," the committee says, "In bituminous road materials which are produced in quantity in the United States is found the agency through which nearly every task of road surface, maintenance or improvement can be performed with the least effort and the greatest probability of success." On the subject of portland cement concrete, the report states, "Because of the length of time required for concrete to acquire sufficient strength for use on roads, concrete is not considered a satisfactory material for road surface repairs in forward areas."

Section 2 of the report relates to "Engineer Equipment and Organization." In this section the committee departs radically from the military road practices of the last war and attempts to conform more closely to present-day highway practice and the demand for speed of movement. The use of combat engineer troops on road tasks is discouraged with the recommendation that such tasks be limited to a very few rudimentary roads or trails required for the passage of guns and other essential features at the extreme front. To take over the more extensive road assignments formerly familiar to division engineers, the committee urges the possibility of special road units with special equipment under army (in distinction to division) control.

Other sections of the report, from 3 to 9, respectively, treat "Grading," "Untreated Gravel Surfacing," "Treated Gravel Surfacing," "Untreated Rock Roads," "Treated Rock Roads," "High-Type Pavements," and "Special Road Expedients." The special road expedients proposed are metal mesh roads, corduroy log roads, corduroy fascine roads, plank roads, and tread roads.

Section 10, the first section of the second main division of the report, is general in scope, and covers organization, materials,basic principles, and bituminous mixtures. General descriptions are given on repair methods to cover dirt roads, gravel surfaced roads, water-bound traffic-bound macadam roads, low and medium types bituminous treated surfaces, high-type bituminous surfaces, and portland cement concrete surfaces. In completing the report it is the intent of the committee to cover in readily usable detail the manufacture of bituminous repair materials and their application under many variable conditions which might occur during war.

The personnel of the Military Roads Committee of the Highway Division includes: W. C. Baker, Jr., Captain, Corps of Engineers, Ft. Belvoir, Va.; B. E. Gray, Colonel, Engineer-Reserve, chief engineer, Asphalt Institute, New York, N.Y.; M. B. Hodges, M. Am. Soc. C.E., maintenance engineer, Texas Highway Department; L. V. Murrow, Assoc. M Am. Soc. C.E., Lieutenant Colonel, National Guard Air Corps, director of highways, State of Washington; O. J. Todd, M. Am. Soc. C.E., Engineer, U.S. Bureau of Reclamation, Denver, Colo.; and W. N. Carey, M. Am. Soc. C.E., Colonel Engineer-Reserve, consulting engineer, St. Paul, Minn., chairman.

National Defense Construction

News of Recent Developments

CONGRESS has finished its work on the National Defense Program for this session and has been marking time preparatory to adjournment. Now the government departments are rapidly translating the congressional appropriations into contracts for goods, engineering services, and for construction.

The Construction Division of the Quartermaster Corps, according to Brig. Gen. C. D. Hartman, chief of the Division, is charged with the expenditure of $1,147,000,000 for building 265 projects scattered all over the country. These include 33 manufacturing plants for ordnance and chemical-warfare production; 14 storage warehouse projects; 54 new cantonments for the selective service army, with capacities up to 20,000 men; and 71 air corps training establishments. Already about one-third of this program is under contract.

BUREAU OF YARDS AND DOCKS SEEKS RESERVE OFFICERS

Enrolment of suitable candidates in the Civil Engineer Corps of the U.S. Naval Reserve is being made in an effort to fill the many vacancies which exist in that corps at the present time. Applications from candidates who will accept active duty immediately after being commissioned are particularly desired. Each candidate for enrolment should submit his application to the commandant of the Naval District in which he resides, from whom information and instructions regarding procedure may be obtained.

The general requirements for the Civil Engineer Corps Reserve of the Navy are that the applicant be a citizen of the United States; be a graduate with a good scholastic record from an engineering school of accredited standing; that he have sufficient practice of the profession to demonstrate ability and promise; that he obtain recommendations regarding character and engineering ability; and that he be possessed of an excellent physical condition as determined by a rigid examination by officers of the Medical Corps of the Navy. There are openings in the grade of Ensign, Lieutenant (j.g.), Lieutenant, and a few as Lieutenant Commander. No application will be received from applicants over 50 years of age.

The duties of the Bureau of Yards and Docks comprise all that relate to the design and construction of public works, such as dry docks, marine railways, building ways, harbor works, quay walls, piers, wharves, slips, dredging; floating and stationary cranes; power plants, coaling stations; heating, lighting, telephone, water, sewer, and railroad systems; roads, walks, grounds, and bridges; and all buildings for whatever purpose needed by the Navy and the Marine Corps. Officers in the Civil Engineer Corps of the Navy are not required to drill nor are they called upon for camp service.

DEFENSE HOUSING PROJECTS DEVELOPING

The initial $100,000,000 appropriated by Congress for defense housing purposes was equally divided between the Army and the Navy for housing families of naval and military personnel. The Public Buildings Administration of the Federal Works Agency has been charged with the construction of the Army's $45,000,000 share of this appropriation. The Navy, on the other hand, is handling the construction of its $45,000,000 share through the Civil Engineer Corps of the Navy, Bureau of Yards and Docks.

A second appropriation of $150,000,000 in the Lanham Bill is primarily for industrial defense housing, that is, for housing workmen and families engaged in the industries at work on the national defense program. The Federal Works Agency has been charged with the expenditure of the Lanham Bill money. The selection of some 63 defense housing areas has been approved to date. Standard plans are being developed rapidly, but definite commitments for the expenditure of the Lanham Bill money are yet to be made.

The extent to which private engineers, architects, and contractors will be used on the defense housing projects is still undetermined. Both the Public Buildings Administration acting direct, and the U.S. Housing Authority acting through local Housing Authorities, have defense housing projects under construction. Representatives of the American Institute of Architects, the Society, and the American Society of Landscape Architects are preparing a statement of the division of responsibility among these professions when and if engaged on national defense housing projects.

National Roster of Engineers Requires Cooperation of Members

UNDER immediate preparation is a "National Roster of Scientific and Specialized Personnel," a Government effort in which the Society is cooperating. All corporate members should have received the necessary blank forms with franked envelope for reply. Advance notice of this and preliminary details were given in the July issue.

Information is required on two blank forms. The larger of these is a comprehensive statement of personal data, indicating educational, military, family, and other background. A smaller form is a "technical check list," for the purpose of indicating the fields of engineering activity engaged in, and the functions performed.

As an aid in this important national effort, the Society Headquarters (1) prepared the addressed envelopes to members, by use of its membership stencils; (2) ran off a duplicate of these addresses as a card index; and (3) drew up the form of the questionnaire blank covering the check list. In addition the Secretary of the Society is serving as a consultant in the present convass.

As a simple matter of patriotism, all members should lend their most cordial cooperation to this effort. This duty is entirely aside from any personal advantage that may accrue through possible later employment. Physical limitations dictated that only corporate members could be included at the present time. It is anticipated however that Juniors also will be canvassed as soon as feasible.

By promptly filling out and returning these questionnaires, members will contribute important assistance to the Government in the national emergency.

Presenting the Index for CIVIL ENGINEERING 1940

ONE OF THE special services rendered by the Society to its members is the issuance of a yearly index to CIVIL ENGINEERING. This appears in the last number for the year—which means that the index for 1940 is to be found in this issue. For those who keep their copies for later use, it is particularly handy, and in any case it provides a means of ready reference to the material that has appeared in CIVIL ENGINEERING throughout the year just ended.

The advantage of having the index come out with the December number, at the end of each volume, is especially evident if the twelve issues are to be bound before the end of the year. The index is printed in a separate form, at the very end of the issue, making it possible, simply by unloosening the wire staples, to remove it intact, either for filing or for binding. The first page of the index is designed to constitute a fitting title page for the bound volume of twelve issues if the index is bound in at the beginning of the volume. For those who may require them, reprints of the index alone are available at a cost of 15 cents.

From an editorial standpoint the difficulties in getting the index ready to appear in December, so as to include the number in which it appears, are obvious. However, the appreciation of many members, engineering offices, and libraries, who desire to make immediate use of it, indicates that the additional labor is warranted.

Treasure Island Wood Framing Tested

San Francisco Committee Will Investigate Joints, Panels, Piles, and Frames During Dismantling

REALIZING that a rare opportunity would be afforded by the demolition of the exposition structures at Treasure Island, a number of interested groups have collaborated with the San Francisco Section in preparing for an extensive series of tests on timber construction elements.

Six types of tests have been planned. Of first importance is the series to be made on the various types of joints. These will include split ring connections, bolted joints, nailed joints, rod and block joints, strap and pin joints, and several others. About eighty joints will be tested in direct tension and compression in addition to being subjected to moments and shears. Tests on the many wall panels of plywood and diagonal sheathing will follow the joint tests. These two types of sheathing were attached with both wire nails and roofing nails and to studs which varied from 16 to 48 in. center to center. Panels are to be tested in direct bending and shear.

Another series of tests will be made on the lateral-load-resisting ability of piles. Because there is very little information available on this subject, it is felt that a fairly extensive investigation is justifiable. On Treasure Island there are many groups of piles which will permit the tests to be made thoroughly and economically.

Some of the numerous types of trusses to be found on the island are also to be tested. Full-size experiments will be conducted on trusses which have from 35 to 50-ft spans. Rigid frames, arches, arch ties, and built-up members may be included.

First consideration was given the subject when a committee was appointed by Section President F. H. Fowler in November 1939. This committee included W. P. Day, H. D. Dewell, H. B. Hammill, J. J. Gould, L. H. Nishkian, chairman, and H. C. Vensano. The original thought was to perform the test program after the close of the 1939 Exposition. However, when it was decided to reopen the Fair in 1940, the committee adjourned until President Hammill called it together in September 1940. The committee was enlarged by the addition of John Cahill, Jr. The outcome of the recent meetings is a $4,600 donation by the Timber Industries, and an application to the WPA through the sponsorship of Dr. W. C. Pomeroy of the University of California for the additional sum of $20,400. The committee has also been assured of the cooperation of Clarence Seage, Assoc. M. Am. Soc. C.E., chief engineer of the California Commission, George Creel of the U.S. Commission, and H. C. Bottorff of the Exposition Company. At the suggestion of the West Coast Lumbermen's Association, and with the approval of the committee, John J. Gould, Assoc. M. Am. Soc. C.E., former chief structural engineer of the Golden Gate International Exposition, was appointed to take charge of the technical phases of the program. Henry J. Degenkolb, Jun. Am. Soc. C.E., and Byron L. Nishkian are assisting Mr. Gould.

Easier Payments for Juniors Seeking Transfer

Juniors who have suppressed their inclination to transfer for reasons best known to the family budget will welcome the recent action of the Board of Direction (October, at Cincinnati) in granting a more comfortable period within which to meet the increased costs of transfer to the Associate grade. Juniors may now have six months after the transfer is approved to pay the extra amount of the dues for the remaining months of the year and the difference between the initiation fees for the two grades. This payment can be made in three installments, and in special cases the time can be further extended. Also, the higher dues of the Associate Member grade are to be paid for only the portion of the year that one is in that grade.

The present change combined with other actions of the Board during the last two years eliminates any real hardships incident to transfer. The 33-year age limit on Junior membership was extended by the Board's previous interpretation granting an additional year, provided the application is submitted before the 33rd birthday. This is an advantage particularly to Juniors who may need the few extra months to complete their year of responsible charge.

For the legally minded members who like their tonic undiluted, the language of the Board "installment plan" resolution is reproduced on page 796 in the Secretary's Abstract of the Board Meeting Minutes. The previous action relating to age limits is indicated in Civil Engineering for March 1939, page 189.

Society Notes

Intended both as a source of inspiration to harrassed program committee chairmen and as a record of valuable information, a list of talks made during the academic year 1939–1940 by Society members and others before Student Chapters has been compiled and mailed to the faculty members and contact members for the Chapters and to Chapter presidents and secretaries.

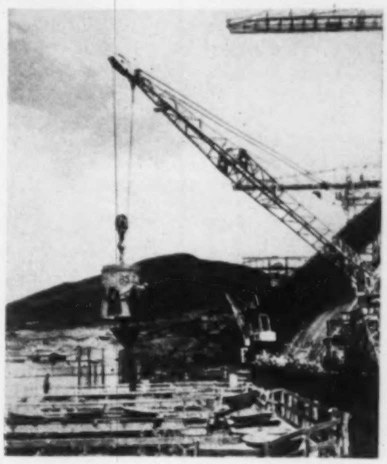
* * * *

By a curious coincidence, the 1940 volume (Vol. 105) of Transactions contains 855 pages of discussion and 857 pages of papers subject to discussion.

Society Offers Series of Lantern Lectures to Students

For the twelfth year, the Society is making lantern lectures available for Student Chapter programs. These lectures consist of lantern slides with mimeographed descriptions, covering a number of important engineering projects. They are sent to any Student Chapter (or Local Section or other interested group) without charge.

The lecture on Grand Coulee Dam has been added to the series this year, and the one on Mississippi River Flood Control has been completely revised. In order to bring this lecture up to date it was necessary to have it entirely rewritten and a new set of slides prepared.



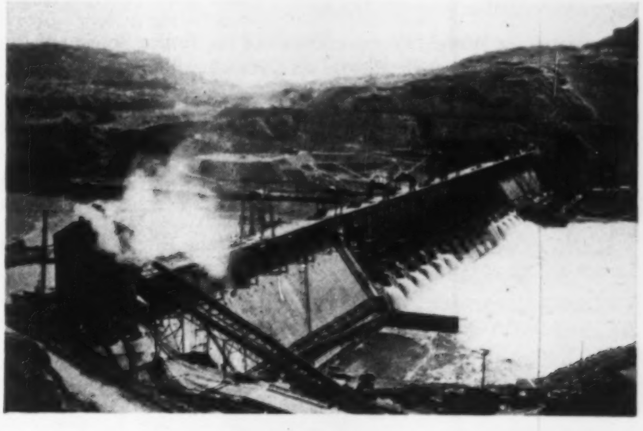
Lantern View from Lecture on Grand Coulee Dam

Funnel Erected to Carry Concrete from Bucket Into Narrow Forms of Power House Foundation

The variety of subjects included in the series is shown in the following list, which gives the title of each lecture and the number of slides it contains:

Lectures	Slides
Aerial Photographic Mapping	59
Bonneville Dam	61
Boulder Dam	75
Carquinez Strait Bridge	58
Cascade Tunnel	45
Catskill Water Supply	67
Conowingo Hydroelectric Development	46
Coolidge Dam	57
Florianopolis Bridge	36
Foundation Problems of West Side Elevated Highway—New York	57
George Washington Bridge	74
Golden Gate Bridge	52
Grand Coulee Dam	60
Hetch Hetchy Water Supply	65
Holland Tunnel	58
Miami Flood Control	53
Mississippi Flood Control	64
Power Development at Niagara Falls	34
San Francisco–Oakland Bay Bridge	70
Westchester County Park System	38
Wilson Dam at Muscle Shoals	47

Reservations should be made well in advance of the date when the slides are to be shown. Experience has proved that those who wait until the last minute have often been unable to obtain the particular lecture desired.



River at High Level Pouring Through Slots in Dam in the Summer of 1939

Another Slide from the Grand Coulee Series

New Honorary Members

AS A RESULT of its meeting in Cincinnati on October 14, the Board of Direction announced the election of five new Honorary Members in the Society. The following members were accorded this great distinction: C. P. Berkey of New York, N.Y.; G. H. Fenkell of Detroit, Mich.; J. D. Galloway of San Francisco, Calif.; F. G. Jonah, of St. Louis, Mo.; and R. H. Thomson of Seattle, Wash.

Professor Berkey has long been a professor of geology at Columbia University and an officer of the Geological Society of America. He has been consultant on some of the most important tunnel, dam, and other projects in this country, not to mention field work in Central Asia.

In a long and notable practice, Mr. Fenkell has served the city of Detroit almost continuously for his entire professional lifetime. Much of the time he served as commissioner of public works and as general manager of the Department of Water Supply. Since his retirement he has been a consulting engineer.

For most of his professional career, Mr. Galloway has practiced in and around San Francisco. He has been consultant on buildings, dams, power plants, bridges, and other major pieces of work; and did notable service as chairman of the Society's Committee on Effects of Earthquakes on Engineering Structures.

Colonel Jonah, a Canadian by birth, has been in engineering work in the United States since 1890. Continuously, following 1901, he has been connected with the Frisco Railroad System—since 1913 as chief engineer.

Mr. Thomson has long served with distinction in the employ of his home city, Seattle. As city engineer for many years, he was in responsible charge of important re-grading and other major improvements. He also is now a consulting engineer.

In some subsequent issue a more detailed account of the great accomplishments of these men will be given. The award of the honorary memberships is scheduled for the Annual Meeting in January.

News of Local Sections

Scheduled Meetings

CINCINNATI SECTION—Dinner meeting at the Student Union, University of Cincinnati, on December 10—dinner at 6:30 p.m.; meeting at 8 p.m.

CLEVELAND SECTION—Luncheon meeting in the Bridge Room, Guildhall, on December 2, at 12:15 p.m.

COLORADO SECTION—Dinner meeting on December 9, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers Club on December 16, at 12:15 p.m.

GEORGIA SECTION—Luncheon meeting at the Atlanta Athletic Club on December 9, at 12:30 p.m.

ILLINOIS SECTION—Dinner meetings of the Junior Section at the Y.M.C.A. (19 S. La Salle Street) on December 9 and 30, at 6 p.m. (program at 7).

INDIANA SECTION—Dinner meeting in Hurty Hall, Indiana State Board of Health, on December 6, at 6:15 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on December 11, at 6:30 p.m.

MARYLAND SECTION—Dinner meeting at the Engineers Club on December 10, at 6 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on December 18, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on December 5, at 7 p.m.

NASHVILLE SECTION—Dinner meeting at the Kissam Hall Restaurant, Vanderbilt University, on December 3, at 6:30 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union on December 2, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers Club, Philadelphia, on December 10, at 6 p.m.

PITTSBURGH SECTION—Talk at the William Penn Hotel on December 11, at 8 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday, at 12:10 p.m.; dinner meeting of the Junior Forum at Hart's Restaurant on December 11, at 6:30 p.m.

ST. LOUIS SECTION—Dinner meeting on December 6, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers Club of San Francisco on December 17, at 5:30 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on December 13, at 12 m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on December 10, at 5:54 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on December 2, at 12:10 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on December 9, at 12:15 p.m.

TRI-CITY SECTION—Dinner meeting at Rock Island, Ill., on December 13, at 6:30 p.m.

Recent Activities

CENTRAL ILLINOIS SECTION—*Urbana, October 23:* This session was devoted to discussing the proposed Illinois Professional Engineering Act. *Springfield, October 25:* The meeting had been arranged for the purpose of acquainting engineers eligible for membership in the Section with the work of the Section. Robert B. Brooks, Director of the Society and member of the Missouri State Highway Commission, discussed the work of the Society in connection with engineering salaries, American Engineering Council, and national defense.

CENTRAL OHIO SECTION—*Columbus, October 24:* Following a business meeting, H. E. Nold, chairman of the department of mining engineering at Ohio State University and president of the Ohio Society of Professional Engineers, gave a talk on "The Professional Welfare of the Engineer." The Section reports that the following officers have been elected for the coming year: Carl V. Youngquist, president; Charles W. Allen, first vice-president; Fred E. Swineford, second vice-president; and Eric T. Krumm, secretary-treasurer.

CLEVELAND SECTION—*October 21:* The guest of honor and speaker of the evening was George T. Seabury, Secretary of the Society, who discussed the civil engineer in national defense, emphasizing particularly the problems facing the Society in this connection.

ITHACA SECTION—*October 17:* At this meeting the following officers were elected for the coming year: Carl Crandall, president; Howard T. Ware and George J. Watson, vice-presidents; and John E. Perry, secretary-treasurer. An illustrated talk on bird and animal life in the national parks—given by Arthur A. Allen, professor of ornithology at Cornell University—comprised the program.

KANSAS CITY SECTION—*September 26:* The feature of the evening was a talk on "The Technique of Anti-Aircraft Artillery," which was presented by Lt. Col. G. G. McCaustland, of the Coast Artillery Reserve.

KANSAS SECTION—*Topeka, October 18:* During the business meeting it was announced that the Board of Direction had approved changing the name of the Section from the Kansas State Section to the Kansas Section. "Cement Soils Stabilization" was the subject of a talk given by H. W. Johnson, of the Portland Cement Association. Mr. Johnson supplemented his remarks with motion pictures.

KENTUCKY SECTION—*Gilbertsville, October 11:* A group of members and guests met in the afternoon for inspection of the construction work in progress on Kentucky Dam. Following a dinner in the Community House, a symposium on the project was presented under the chairmanship of G. P. Jessup, project manager for the TVA Those taking part in the symposium were E. A. Prokop, reservoir construction engineer; S. H. Smith, engineer in charge of reservoir activities; J. B. Hays, construction engineer for the TVA on the project; and B. S. Philbrick, superintendent of construction.

SCENE AT ANNUAL BANQUET OF MID-SOUTH SECTION

LEHIGH VALLEY SECTION—*Easton, Pa., October 28:* The speaker of the occasion was E. L. Durkee, of the Bethlehem Steel Company, who gave an illustrated lecture on the construction of the Baton Rouge Bridge. Mr. Durkee was resident engineer on the project. A dinner at Lafayette College preceded the meeting.

LOS ANGELES SECTION—*October 9:* A symposium on engineering education was the feature of the occasion, the speakers being: G. Montague Butler, dean of the college of mines and engineering at the University of Arizona; F. W. Panhorst, bridge engineer for the California State Division of Highways; H. Macy Jones, secretary of the California State Board of Registration for Civil Engineers; and Sterling S. Green, president of the Junior Forum. The latter discussed the subject from the viewpoint of the young engineer. Before the regular meeting the Junior Forum held a round-table discussion of the meaning of the phrase, "Responsible Charge of Work."

LOUISIANA SECTION—*Baton Rouge, October 24:* Joint meeting with the Student Chapters at Louisiana State University and Tulane University. In the afternoon a large group visited the Standard Oil Company's new wharf now being erected by the W. Horace Williams Company near Baton Rouge. In the evening the Section held a meeting at Louisiana State University. The technical program consisted of an illustrated paper on the design and construction of the wharf, presented by C. G. Cappel, engineer in charge of construction.

METROPOLITAN SECTION—*October 16:* On this occasion the Section was host to the officers of the Civil Engineer Reserve Corps of the U.S. Navy who are in the Metropolitan district. The speaker was Rear Admiral Ralph Whitman, public works officer of the Third Naval District, who discussed "Public Works of the Navy and National Defense."

MICHIGAN SECTION—*Detroit, October 23:* Officers for the coming year were announced as follows: E. L. Eriksen, president; L. C. Wilcoxen, first vice-president; Milton P. Adams, second vice-president; and Clair C. Johnston, secretary-treasurer. Theodore Leisen, former Director of the Society, spoke briefly, and D. Grant Mickle, traffic engineer of Detroit, discussed the general problem of transportation in urban areas.

MID-SOUTH SECTION—*Memphis, Tenn., October 25 and 26:* More than a hundred members and guests registered for the eleventh annual meeting of the Section. High lights of the occasion were the joint luncheon with the Engineers' Club of Memphis, held Friday noon, and the banquet in the evening. The speaker at the luncheon was C. M. Ripley, of the General Electric Company, who discussed the subject, "Electricity—the Master Tool of Management." The feature of the banquet was an address on "The Civil Engineer in National Defense," given by Frank M. Andrews, of the General Staff of the U.S. Army. A program of music and dancing was also presented under the chairmanship of Robert J. Woods, Jr. The morning session on the 25th was devoted to engineering education and featured scheduled addresses by H. N. Howe, N. B. Garver, and W. R. Spencer. Speakers at the afternoon session, which consisted of a symposium on "Construction in the Mid-South Area," were W. C. Johnson, W. B. Fowler, John A. Fox, and Lt. Col. Daniel Noce. There was considerable discussion of all the main papers. The morning session on the 26th included a Junior Forum and election of officers for the coming year. These are as follows: Frank V. Ragsdale, president; Robert C. Gibson, vice-president; and James R. Newman, secretary-treasurer. Attendance at the Arkansas-Mississippi football game Saturday afternoon concluded the session.

NEW MEXICO SECTION—*October 26:* Joint inspection trip with the University of New Mexico Student Chapter. The group visited Conchas Dam and canal and the Tucumcari Irrigation Project. The U.S. Bureau of Reclamation supervised the trip, and members of the Corps of Engineers aided in conducting the group about the dam.

NORTH CAROLINA SECTION—*Charlotte, October 18:* Joint meeting with the Piedmont Section of the American Society of Mechanical Engineers. The technical program presented at this time included talks by G. S. Rawlins, consulting engineer of Charlotte, who described the water-distribution system in that city, and Walter Franklin, plant superintendent of the Charlotte water works, who spoke on water purification there. Both papers were discussed. Following a dinner in the evening, D. Nabow, of the Duke Power Company, presented a paper on "The New Steam Power Plant at Cliffside."

NORTHEASTERN SECTION—*Junior Association, October 3:* Two members of the Junior Association—Herman J. Shea and Malcolm Stevens—addressed this supper meeting. Mr. Shea discussed "Recent Trends in Aerial Photogrammetry," while Mr. Stevens spoke on air raid shelters. Both young men are members of the staff at Massachusetts Institute of Technology.

NORTHWESTERN SECTION—*Minneapolis, November 4:* The meeting was in charge of the Junior Section. The technical program consisted of a talk on engineering in Hawaii, which was given by Russell C. Brinker, assistant professor of structural engineering at the University of Minnesota.

OREGON SECTION—*October 29:* A symposium on the Bonneville Project was presented under the chairmanship of Charles E. Carey, chief consulting engineer for the Bonneville Power Administration. Those taking part in the program were Dr. Paul J. Raver, administrator; S. E. Schultz, chief engineer; Don S. Campbell, chief of the transmission unit; and Ben W. Creim, principal engineer.

PHILADELPHIA SECTION—*October 8:* The principal speaker was E. L. Durkee, resident engineer for the Bethlehem Steel Company on the construction of the Baton Rouge Bridge, who described the erection of the superstructure, amplifying his remarks with motion pictures. Others who spoke on the subject were Leon S. Moisseiff, consulting engineer of New York; Charles F. Goodrich, chief engineer of the American Bridge Company; and Lester L. Lessig, contracting engineer for the Bethlehem Steel Company.

PITTSBURGH SECTION—*October 18:* Lt. Col. Percy G. Black addressed a joint meeting of the Pittsburgh Section and the Engineers' Society of Western Pennsylvania on the subject of "Mechanical Warfare in Europe." *Junior Division, October 24:* Adolph J. Ackerman, director of engineering for the Dravo Corporation, conducted a round-table discussion on the "Problems of the Young Engineer."

Sacramento Section—*October 1, 8, 15, 22, and 29:* At the first of these regular weekly luncheon meetings four reels of motion pictures showing the processes of manufacturing wrought steel pipe were shown, and Jack Frye, president of the Transcontinental and Western Airlines, Inc., spoke on "Commercial Aircraft in War Service." Speakers at the other gatherings were Phil Dickinson, of the U.S. Bureau of Reclamation; Dr. Nathan A. Bowers, Pacific Coast editor of *Engineering News-Record;* Julian Hinds, assistant chief engineer of the Metropolitan Water District of Southern California; and J. E. Jellick, manager of the San Francisco office of the Portland Cement Information Bureau. *Junior Forum:* The speaker at the monthly dinner meeting of the Forum was W. A. Perkins, senior engineer of dam inspection for the California State Division of Water Resources. The talk was followed by an engineering quiz contest.

St. Louis Section—*October 28:* Following a business discussion, Russell H. Riley, of Harland Bartholomew and Associates, presented a paper on the decentralization of cities. It was announced that the following engineers have been elected for 1941: F. C. Woermann, president; Hymen Shifrin, first vice-president; L. B. Feagin, second vice-president; and M. Buchmueller, secretary-treasurer.

San Francisco Section—*October 15:* The speaker and guest of honor was Col. R. O. Dart, chief of laboratory service and director of sanitary investigations for the Ninth Corps Area of the U.S. Army. Colonel Dart's talk was entitled "Sanitation in the Army." *Junior Forum, September 17:* A talk on "Construction Features of the New Steam Electric Generating Plants of the Pacific Gas and Electric Company" was given by F. F. Mautz.

Spokane Section—*August 9, September 7 and 13, and October 18:* The Section reports that the sessions on August 9, September 13, and October 18 were devoted to business discussion, the emphasis at the latter meeting being the cost of Society conventions. On September 7, Joseph Jacobs, Vice-President of the Society, was guest of honor at a special dinner meeting and spoke on the problems of the Society.

Syracuse Section—*October 14:* Joint meeting with the Technology Club of Syracuse. The speaker and guest of honor was Ernest F. Robinson, chief engineer of the Maracaibo Harbor Commission, who gave an illustrated lecture on the subject, "An Engineer's Experiences in South America." Prior to the meeting the Section entertained Colonel Robinson at a small dinner.

Tacoma Section—*October 8:* A description of the history and design of the Willamette Basin Project in Oregon was given by Col. C. R. Moore, district engineer for the Portland District of the U.S. Engineer Office.

Texas Section—*Denison and Dallas, October 17–19:* The first session of the three-day fall meeting of the Section was held in Denison, where the group was greeted by City Attorney Ross Stoddard, substituting for the mayor who was ill. Motion pictures of the construction of Denison Dam were then shown as a preliminary to inspection of the project that took place after lunch. Following a buffet supper in the evening, the group adjourned and moved to Dallas, where an informal social evening was enjoyed. The technical session held the next morning was welcomed by James W. Aston, city manager of Dallas, while Robert J. Cummins responded for the Section. Papers on different aspects of the Denison Dam were then given by M. E. Schmidt, H. L. Johnson, and J. B. Alexander. At the luncheon that followed James Follin, chairman of the Society's Committee on Local Sections, discussed the activities of the committee and greeted the various Student Chapter presidents who were there. Dr. Humphrey Lee, president of Southern Methodist University, then spoke on the social and economic problems facing technically trained men. In the afternoon the Student Chapter members met on the campus of Southern Methodist University, and the others gathered to hear further discussion of Denison Dam, the principal speakers being E. J. Wanless and Capt. Gordon Textor. Maj. John B. Hawley then presented a comparison of the "Standard Form of Contract," as prepared by the Texas Section, with one prepared by the Association of Consulting Engineers of England. The regular dinner dance took place that evening, and Saturday morning there was a Student Chapter breakfast. During the business meeting held later in the morning the following officers were elected to serve during the coming year: H. N. Roberts, president; Grayson Gill and W. H. Mead, vice-presidents; and John A. Focht, secretary-treasurer.

Student Chapter Group Enjoying the Fall Meeting of the Texas Section

Tri-City Section—*Davenport, Iowa, September 27:* All engineers in the vicinity were invited to attend a smoker, which inaugurated the fall program of the Section. The feature of the occasion was a talk by H. W. Poston, sanitary engineer in the Division of Sanitary Engineering of the Iowa State Department of Health, who discussed the malaria-control survey now being conducted by the U.S. Public Health Service along the Upper Mississippi.

Wisconsin Section—*October 10:* H. M. Hilton, of the Aluminum Company of America, presented two films—one depicting an unusual method of constructing a concrete dam on the Saguenay River in Canada, and the other showing the aluminum industry from the mining of ore to the completion of various fabricated products.

Wyoming Section—*Cheyenne, October 14:* Joint dinner meeting with the Cheyenne Engineers' Club. The feature of the evening was a talk on "Public Relations for Engineers," given by J. I. Ballard, editor of *Western Construction News*. An open discussion of the subject was conducted by C. F. Seifried, president of the Section.

Student Chapter Notes

College of the City of New York—*October 24 and 31:* The speaker at the first of these sessions was Andre Halasz, a member of the drafting department at the College of the City of New York, who spoke on the esthetics of bridge design. Albert Dick, assistant engineer in the Division of Design of the Borough President of Manhattan, discussed the subject, "Design and Construction of a Sanitation Dumping Board," at the second meeting.

Manhattan College—*October 9 and 30:* The Chapter reports that its speakers were Brother Leo, dean of engineering at the college, and I. Berg, architect. The latter discussed architectural engineering.

Newark College of Engineering—*October 14:* "The Civil Engineer in National Defense" was the subject of a talk given by Allan R. Cullimore, president of the Newark College of Engineering.

New York University—*October 2 and 30:* The first of these meetings was devoted to business discussion. At the second gathering Dr. Hamilton Gray, newly appointed member of the faculty at New York University, discussed the theory of soil mechanics.

Rutgers University—*October 4:* Since this was the first meeting of the year talks were given by both Faculty Adviser Mirgain and Contact Member Goodkind. Both discussed the value of membership in the Society to the engineer. The meeting was then turned over to Paul K. Seaman, member of the present senior class, who described his experiences while working for the Kellogg Foundation during the past summer.

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for January

ORIGIN of the term "S. I.," sometimes applied to civil engineers with doubtful affection, becomes apparent after a reading of the article C. Frank Johnson has prepared describing the procedure used in surveying the sewer system of Louisville, Ky. He gives the results of the investigation with concrete detail that may prove helpful in other communities with similar problems.

A review of foundation construction methods is presented in a thorough-going paper written by Ralph H. Chambers. Piles, caissons, and driving methods are generously illustrated from examples of actual field work. Mr. Chambers has crowded a great deal of useful information into a small space without waste of words.

Frank M. Johnson, in an enlightening account of the work of the General Land Office, explains the origin and purpose of cadastral surveys. The necessities of agricultural settlement were succeeded by the problems of location and description as westward moving population encountered railroad claims, Spanish grants, or Indian reservations. In citing the work of the boundary and park surveys, he treats a subject that holds much if not most of the romance of civil engineering.

Most civil engineers, being skeptics by profession, will also enjoy a cold factual comparison of the relative merits of alternate designs. A comparison based on carefully controlled tests approaches the engineer's dreams of the perfect paper. David S. Jenkins may therefore claim distinction for his discussion of comparative tests on silt samplers and of their ability to produce representative samples. He nails down the question, "Are silt samplers psychic?"

Also tentatively planned for the January issue are papers dealing with primitive houses of the Far East, some too frequently neglected aspects of soil studies for highway fills, and the defense construction program of the Tennessee Valley Authority.

New Queens Elevated Highway

USE of a pneumatic wrench to drive heavy screw bolts into a steel cover plate is depicted on this month's Page of Special Interest. This operation is one of the final phases in the completion of the work on a new elevated highway in the Borough of Queens, New York City, before opening it to traffic. The Queens elevated highway facilitates traffic movements between points in that borough and midtown Manhattan via the new East River Tunnel which was opened to traffic November 15.

The Second National Surveying Teachers' Conference

By DOUGLAS S. TROWBRIDGE

ASSOC. M. AM. SOC. C.E.
PROFESSOR OF SURVEYING, NEW YORK UNIVERSITY, NEW YORK, N.Y.

THE TECHNIQUE of teaching and practicing surveying, precise surveying and plane coordinates, and photogrammetry was stressed at the Second National Surveying Teachers' Conference held last summer under the sponsorship of the Society for the Promotion of Engineering Education. This eight-day meeting, in charge of Committee VIII of the Civil Engineering Division of the S.P.E.E., was held at Camp Case, the surveying camp of the Case School of Applied Science, in the Mohican State Forest near Loudonville, Ohio. It was attended by 63 men from 31 engineering colleges, government agencies, instrument makers, and private practice. Ladies and children added 38 to this number so that a total of 101 enjoyed the hospitality of the Case School of Applied Science.

DEMONSTRATION OF SMITH SOLAR TRANSIT AT SURVEYING TEACHERS' CONFERENCE

In planning the program a definite attempt was made to allow plenty of time for members to meet informally in small groups. For this reason, most of the meetings were held in the mornings with the afternoons given over to demonstrations, trips, informal group discussions, or recreation. Formal papers presented and discussed were on methods of teaching surveying, precise surveys and plane coordinates, legal aspects of surveying, astronomy, instruments, and photogrammetry, while afternoon or evening demonstrations included work with the solar transit, the simplex solar shield, astronomy, photogrammetry, and new equipment provided by the instrument makers. Trips were made to the Pleasant Hill Dam, the Guggenheim Institute for Lighter-than-Air Research in Akron, Ohio, the Case School of Applied Science, and to inspect the work of the Cleveland Regional Geodetic Survey. Owing to the increasing importance of photogrammetry, two full days were given to this subject in the form of papers, discussions, and demonstrations.

Early in the conference, committees were appointed to study the minimum content of various surveying courses as adopted by the First National Surveying Teachers' Conference held in 1937 and to recommend such changes as were deemed advisable. The conference recognized that there should be some difference in the surveying taught to civil engineering students and those of other branches of engineering but advocated that an elementary course in surveying be required of all engineering students. Recommended contents were adopted for the courses for non-civil engineering students and for civil engineering students, and for courses in applied surveying, higher surveying, route surveys, and photogrammetry.

Realizing the value of surveying and mapping to the defense program, the committee in charge of the conference requested the War Department to send someone to discuss this matter. As a result Captain Dau came from Wright Field and in an informal talk advised the colleges to continue to give plenty of work in the fundamentals of surveying and suggested that, where possible, work in precise control surveying and photogrammetry would be very helpful.

Some discussion was given to the question of the mapping of the United States which, according to the figures presented at the meeting, is only about 25% adequately mapped and which is approximately 50% unmapped. The conference passed a resolution endorsing the joint report of the Secretaries of the Departments of War, Commerce, and Interior, known as Senate Document No. 54, regarding the adoption of a mapping program with the recommendation that this program be fully adopted at the earliest possible time by appropriation of the necessary funds.

WPA Issues Report for Five Years 1935–1940

A SUMMARY of the major types of facilities completed on projects operated by the Work Projects Administration is given in a statement recently released. The program of the Administration was undertaken in the summer of 1935 for the purpose of providing employment on useful public projects. The report gives the number of physical units of various types constructed or improved from the beginning of the program through June 30, 1940.

In the construction field there are listed a total of 517,431 miles of highways, roads, and streets, of which 454,606 miles are rural roads and 54,432 miles are urban streets. A total of 64,426 bridges and viaducts were built, and 39,794 reconstructed or improved. In the utility field 1,736 new plants were built, including electric power plants, incinerator plants pumping stations, and sewage and water treatment plants.

The figures for airports and airway facilities show 197 landing fields newly constructed and 317 reconstructed or improved; 474 new airport buildings and 1,088 reconstructed or improved. (This total includes 167 new hangars and 259 improved.) Among miscellaneous airport facilities built by the Administration are runways, seaplane ramps and landing platforms, floodlighting of landing areas, boundary lighting, drainage work, airway markers, and beacons. Besides utility plants and buildings at airports, 25,796 other public buildings were constructed, and 67,724 improved. A large number of the projects were either sponsored or cosponsored by the War Department, Navy Department, Coast Guard and National Guard, or were undertaken for the construction or improvement of facilities owned or to be used by these agencies.

Activities under the heading of "Conservation, Flood and Erosion Control, and Irrigation" are hard to summarize as they vary from the planting of 7,217.000 bushels of oysters to the placing of 13,432,000 sq yd of riprap. Other items under this head are the building of 15,815 new dams for conservation, flood, and erosion control; 6,926 miles of stream-bed improvement; 4,118 miles of river-bank and shore improvement; 161 fish hatcheries; 4,973 miles of firebreaks; and 960 miles of ditches, canals, pipes, or flumes for irrigation systems.

Altogether the report constitutes a rather impressive muster of construction and conservation activities of interest to the engineer, as well as many others of more miscellaneous character.

More Reserve Officers Ordered to Active Duty

PREVIOUS issues of CIVIL ENGINEERING have listed members of the Society in the Officers Reserve Corps of the Army and in the U.S. Naval Reserve, who have been ordered to active duty. Additional changes of this sort in the Officers Reserve Corps of the Army include Capt. Theodore C. Combs from district manager of the West Coast Lumbermen's Association, to the Presidio of San Francisco; Lt. Joseph S. Evans from W. F. MacConnell and Company, Cincinnati, Ohio, to the Office of the Constructing Quartermaster at Camp Savannah, Hinesville, Ga.; Capt. Franklin W. Fish, Jr., from assistant engineer in the U.S. Engineer Office at Los Angeles, to the office of the Constructing Quartermaster at Fort Ord, Presidio of Monterey, Calif.; Capt. Oliver G. Haywood, Jr., to the 27th Engineer Battalion at Fort Buchanan, P.R.; Lt. Charles Hunnell, Jr., to duty with the regular army in the office of the Quartermaster General, Washington, D.C.; Lt. George B. Schoolcraft from project engineer for the Indiana State Highway Commission to the Quartermaster Corps of the army, with headquarters at Fort Bragg, N.C.; and Capt. Burford M. Tanner from the U.S. Forest Service at Glendora, Calif., to the Office of the Constructing Quartermaster at Anchorage, Alaska.

Of the Naval Reserve there are Lt. Cuthbert P. Conrad from Michigan State College to the Bureau of Yards and Docks in Washington, D.C.; Lt. Charles E. Lewis from South Dakota state plans engineer for the WPA to the 13th naval district at Seattle, Wash.; Lt. William R. Franklin from construction superintendent in the Construction and Equipment Department of Montgomery Ward and Company, Chicago, to the U.S. Naval Training Station at Newport, R.I.; and Lt. Irvin S. Rasmussen from the U.S. Engineer Office at Little Rock, Ark., to the Navy Yard at Philadelphia.

It will be of interest, also, to note that Lacey V. Murrow, director of highways for the Washington State Highway Department, has been granted an indefinite leave of absence to begin new duties as lieutenant colonel in the National Guard Air Corps. Similarly, Maj. William J. Fox, chief engineer of the Los Angeles County Department of Building and Safety, has been called to active service in the U.S. Marine Corps. He will be stationed at the Long Beach naval reserve aviation base, where he will act as an instructor.

Brief Notes

THE American Society of Mechanical Engineers has announced the election of the following new officers, who will be installed at the sixty-first annual meeting of that organization, to be held at the Hotel Astor in New York City, December 2–6, 1940: William A. Hanley, president; Samuel B. Earle, Frank H. Prouty, and Edwin B. Ricketts, vice-presidents (to serve two years); and Huber O. Croft, Paul B. Eaton, and George E. Hulse, managers (to serve three years).

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ALL non-citizen members of the Society are reminded that, under the provisions of the Alien Registration Program, they are required to register by December 26, 1940. Inquiries concerning this program, which went into effect August 27, may be addressed to the Alien Registration Division of the Department of Justice, Washington, D.C.

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MEMBERS interested in filling out their collections of Society TRANSACTIONS with volumes of 1906 and earlier, should get in touch with W. G. Allen, Assoc. M. Am. Soc. C.E., of Carmel, Calif.

NEWS OF ENGINEERS

Personal Items About Society Members

A. A. CASANI has been promoted from the position of assistant to the chief engineer of the American Bridge Company to that of assistant to the president of the company. His headquarters are still in Pittsburgh.

MURRAY D. VAN WAGONER, since 1933 highway commissioner of Michigan, was elected governor of that state on November 5 by a majority of about 100,000 votes. At one time he maintained a private practice at Pontiac, Mich., and he has also been commissioner of Oakland County, Mich. Last year Mr. Van Wagoner served as president of the American Road Builders Association.

JOHN STEARNS has accepted a position as principal engineer in the Bureau of Yards and Docks of the U.S. Navy, on the construction of the fleet operating base at Long Beach, Calif. Mr. Stearns recently completed an assignment as assistant executive director of the Los Angeles County Housing Authority in connection with the construction of the Carmolitas and Harbor Hills housing projects.

DONALD R. WARREN and **FREDERICK J. CONVERSE** have formed the engineering partnership of Warren and Converse, in Pasadena, Calif., for the purpose of making foundation investigations and supplying consulting foundation services.

EARL L. BRADSHAW, previously engineer in charge of the McClellan Water Conservation District of the U.S. Department of Agriculture, has accepted a position as senior engineer in the office of the Constructing Quartermaster, Borinquen Field, P.R.

HUGH J. CASEY has been promoted from the rank of captain, Corps of Engineers, U.S. Army, to that of major, and transferred from Manila, P.I., to Fort Lewis, Wash., where he is with the 10th Engineers.

WELLS H. ASHLEY, until recently assistant engineer in the Washington State Department of Public Lands, has taken a position as associate construction engineer with the U.S. Navy and is located at the Naval Air Station, Seattle.

WALTER J. PLOGSTED is now foreign representative for the General Railway Signal Company at Rochester, N.Y. He was previously managing director of the London office of the company.

CHARLES K. LEWIS has been transferred from the U. S. Engineer Office in Los Angeles, to the Panama Canal, where he is in charge of reports and records in connection with the construction of the Third Locks Project. He is located at Diablo Heights, C.Z.

ARTHUR R. REITTER, formerly designer in the hydraulic design department of the Central Nebraska Public Power and Irrigation District, has accepted the position of director of operations of the National Youth Administration for Nebraska, with headquarters in Lincoln, Nebr.

WILLIAM P. SIMPSON, lieutenant, Corps of Engineers, U.S. Army, is now stationed at Camp Upton, Yaphank, N.Y.

CHARLES U. KRING is the recipient of fellowships from the University of Illinois and the Swiss Federal Polytechnic Institute, the latter given through the Swiss-American Student Exchange of the Institute of International Education. Mr. Krim has sailed for Zurich, where he will study theory of limit design and other aspects of structural engineering.

Thore F. Bengtson has been promoted from the rank of lieutenant, Corps of Engineers, U.S. Army, to that of captain. He will be located at Fort Belvoir, Va.

Charles D. Curran, lieutenant, Corps of Engineers, U.S. Army (Retired), has accepted the position of budget examiner, Bureau of the Budget, Executive Office of the President, Washington, D.C.

Salem David Caplan is now efficiency investigator in the Los Angeles (Calif.) Bureau of Budget and Efficiency.

Lucius D. Clay, major, Corps of Engineers, U.S. Army, has been relieved as district engineer in the U.S. Engineer Office at Denison, Tex., in order to assist the Administrator of the Civil Aeronautics Administration in the proposed emergency airport construction program in Washington, D.C.

Edward R. Van Driest, formerly assistant in hydraulics at the California Institute of Technology, has accepted a position as instructor in the mechanics of engineering at Cornell University. Other recent changes in the engineering school at Cornell include the promotion of **Harold V. Hawkins** from the position of instructor in civil engineering to that of assistant professor, and the appointment of **F. J. Spry**, formerly instructor in railroads, as Marc Eidlitz Instructor in Civil Engineering.

Datus E. Proper, executive vice-president of the Texas Good Roads Association, has been appointed a member of the Aims and Objects Committee of Rotary International, in which capacity he will assist in strengthening and implementing the community service activities of the Rotary clubs throughout the world.

Fred J. Maynard has been promoted from the position of engineer for the George A. Fuller Company, of Atlanta, Ga., to that of chief engineer.

Alexander Allaire, previously connected with H. J. Deutschbein Company, Inc., of New York City, is now with Fraser, Brace, and Company of the same city.

John J. Gromfine, lieutenant-commander, Civil Engineering Corps, U.S. Navy, has been transferred from the Eleventh Naval District at San Diego, Calif., to the U.S. Fleet Operating Base at Long Beach, Calif., where he is resident officer-in-charge.

J. S. Williamson, state highway engineer of South Carolina, was elected president of the American Association of State Highway Officials at the convention held in Seattle in September.

H. Hershey Miller, until recently engineer of tests for the Pennsylvania Turnpike Commission, has accepted a position as resident engineer for the Pennsylvania Sand and Gravel Producers Association, with headquarters at Harrisburg, Pa.

Calvin C. Oleson has resumed his teaching duties at South Dakota State College after a year's leave of absence, during which he served as district concrete engineer with the Pennsylvania Turnpike Commission at Somerset, Pa.

James F. Murphy, for the past two years PWA project engineer on the construction of the Pennsylvania Turnpike, has been appointed chief engineer for the U.S. War Department on the construction of a shell-loading plant at Radford, Va.

Joseph M. Hatchett is now city manager of Petersburg, Va. He was formerly city engineer and acting city manager.

Russell C. Baker is in charge of the newly opened U.S. Engineer Office at Arkabutla, Miss., where he will direct operations for the construction of the $10,000,000 dam on Coldwater River. Previously Mr. Baker was in charge of engineering and inspection in the U.S. Engineer Office at Sardis, Miss.

Guy W. Sackett, vice-president of the the Mason and Hanger Company, has been transferred to Radford, Va., to be in charge of the construction of a smokeless powder plant being built for the Hercules Powder Company.

Gorton W. Brush recently resigned from the Michigan State Highway Department in order to accept a position as plant engineer for the Ingalls Shipbuilding Corporation, with headquarters at Pascagoula, Miss.

George K. Leonard, on the staff of the Tennessee Valley Authority since 1933, has been transferred from the Watts Bar Dam to Cherokee Dam, where he will act as construction engineer. He served in a similar capacity on the construction of both the Guntersville and Watts Bar dams.

David L. Neuman has been promoted from the rank of major, Corps of Engineers, U.S. Army, to that of lieutenant-colonel. He is now stationed at Fort Belvoir, Va.

Henry W. Buck and **Robinson D. Buck**, consulting engineers of Hartford, Conn., have taken over the consulting firm of Greenwood and Noerr, of that city.

John D. Quinn has, with John E. Wiley, organized the Quinn-Wiley Company, with offices at Cheyenne, Wyo. The company will specialize in engineering and business service.

Harold B. Gotaas has been promoted from the position of assistant professor of sanitary engineering at the University of North Carolina to that of associate professor of sanitary engineering.

Adolph Benscheidt, lieutenant, Civil Engineering Corps, U.S. Navy, has been ordered detached from duty at the U.S. Navy Yard, Cavite, P.I., for duty at the Navy Yard, Bremerton, Wash.

Roderic B. Thomas, for the past twelve years city engineer of Highland Park, Tex., has been appointed superintendent of the Dallas (Tex.) water works.

Arthur L. Boley, since 1931 city engineer of Sheboygan, Wis., received one of the 1940 veterans awards of the American Public Works Association at the recent convention of that organization, which was held in Detroit. Mr. Boley has been on the Sheboygan city staff since 1909. **Ernest H. Paffrath**, assistant sewer commissioner of St. Louis, Mo., for the past eighteen years, was the recipient of a similar award, as was **Thomas D. Samuel, Jr.**, chief engineer and superintendent of the Kansas City Water Department.

Russell S. Hummel has succeeded the late William A. Smith as state WPA administrator for Virginia, with headquarters in Richmond. He was formerly assistant state administrator.

James W. Dement, Jr., captain, Corps of Engineers, U.S. Army, has been transferred from Little Rock, Ark., where he was assistant engineer in the U.S. Engineer Office, to Mobile, Ala.

Edward N. Chisolm, Jr., lieutenant-colonel, Corps of Engineers, U.S. Army, is now stationed at Atlanta, Ga.

DECEASED

George Washington Bramwell (M. '93) retired civil engineer of New York City, died there on October 9, 1940, at the age of 89. At one time Mr. Bramwell was in charge of maintenance for the Shenandoah Valley Railroad, and from 1886 to 1910 served as president and chief engineer of the Hydraulic Construction Company of New York. He retired in the latter year.

Howard Constable (M. '92) retired architect and engineer of Princeton, N.J., died there on October 15, at the age of 84. Early in his career Mr. Constable was engaged in the development of railroad construction methods in New York. Later (from 1886 to 1912) he maintained his own offices in New York.

Hugh B. Gibson Dunlop (Jun. '37) inspector for the U.S. Bureau of Reclamation at Coulee Dam, Wash., was killed in a hunting accident on October 10, 1940. He was 30. Immediately following his graduation from Washington State College in 1936, Mr. Dunlop became connected with the Bureau of Reclamation.

Harry Frazier (M. '89) of Richmond, Va., died at Lewisburg, W.Va., in October 1940. Mr. Frazier, who was 79, retired several years ago as consulting engineer for the Chesapeake and Ohio Railway, after many years of service in this capacity.

Herbert Clifford Hartwell (M. '08) an engineer in the maintenance department of the Boston (Mass.) Elevated Railway, died at Milton, Mass., on October 27, 1940. Mr. Hartwell, who was 65, had been connected with the Boston Elevated Railway since 1898.

John Augustus Hiller (Assoc. M. '04) consulting engineer of Cincinnati, Ohio, died on October 21, 1940, at the age of 67. From 1897 to 1908 Mr. Hiller was in charge of the construction of new water works for Cincinnati; from 1908 to 1914, superintendent of the Cincinnati water distribution; and from 1914 to 1930, general superintendent of the Cincinnati water works. In the latter year he established his consulting practice.

Percival Maximilian Infante (M. '28) for the past two years assistant engineering designer for the New York City Board of Water Supply, died suddenly on October 9, 1940. Mr. Infante, who was 60, was born in England and educated in Scotland. Before the World War he was civil engineer and builder of the Benguela Railroad in British East Africa. Later he built three hydroelectric plants for the Colombian government and supervised the construction of irrigation works there.

David Read Lee (M'10) of Syracuse, N.Y., died in November 1938, though the Society was not notified of his death until recently. Mr. Lee spent much of his career in the service of the New York State Department of Canals, and lived in Syracuse.

Richard McCulloch (Assoc. M. '98) trustee of the Beggs Estate, St. Louis, Mo., died in Milwaukee, Wis., on August 28, 1940, at the age of 71. Mr. McCulloch was president of the United Railways Company, St. Louis, from 1904 to 1919, and vice-president of the St. Louis Car Company from 1919 to 1925. From the latter year on he was trustee of the Beggs Estate.

Thomas Knight Mathewson (M. '07) of Santa Ana, Calif., died in that city on May 2, 1940, though the Society has just learned of his death. He was 70. Mr. Mathewson's career included work in railroad surveys, construction, and maintenance in this country, Mexico, Cuba, and South America. From 1917 until 1930 he was in Santiago, Chile, where he was in charge of the design and construction of a large hydroelectric development near that city. He moved to Santa Ana in the latter year.

William Benson Storey (M. '89) retired president of the Atchison, Topeka, and Santa Fe Railroad, died at his home in Chicago on October 24, 1940. Mr. Storey, who was 82, was with the Atchison, Topeka and Santa Fe Railroad from 1903 until his retirement in 1933, serving successively as chief engineer, vice-president, and president. After his retirement he remained as a director and member of the executive committee. Earlier in his career he had been with the Southern Pacific and the San Francisco and San Joaquin Valley Railroad. From 1906 to 1908 Mr. Storey was a Director of the Society.

William B. Storey

James Emerson Phillips (M. '31) engineer for the Los Angeles (Calif.) Department of Water and Power, died in that city on October 26, 1940, at the age of 57. In 1912 Mr. Phillips joined the Los Angeles city water department as draftsman, advancing later to the position of engineer. Earlier in his career he was with the Chicago and Western Railway, and he had been in private practice at Rockville, Ind., and Portland, Ore.

Henry Bowman Seaman (M. '87) consulting engineer of Brooklyn, N.Y., died on October 24, 1940, at the age of 79. Early in his career Mr. Seaman was with the Pennsylvania Railroad and the Edgemoor Iron Works. From 1907 to 1910 he was chief engineer of the Public Service Commission of New York City and, later, took charge of the general improvement of the New York, New Haven and Hartford Railroad. At various times he maintained a consulting practice, serving the New York City Department of Bridges, the WPA, and various other agencies. He was noted for introducing many of the fundamental techniques of subway construction. From 1900 to 1902 Mr. Seaman was a Director of the Society.

Ralph Darwin Wichman (Assoc. M. '23) for some years in the Bureau of Engineering, City and County of San Francisco, died on September 22, 1940, at the age of 57. Earlier in his career Mr. Wichman was with the Mt. Whitney Power and Electric Company (for six years); spent two years in Burma as construction engineer for the Burma Corporation Ltd.; and served as electric engineer for the Pacific Gas and Electric Company.

George Pillsbury Wood (M. '11) since 1929 superintendent of the Peekskill (N.Y.) Board of Water Commissioners, died at his home there on October 15, 1940. He was 72. Mr. Wood was with the New York City Board of Water Supply from 1906 to 1917, and from the latter year until 1929 maintained his own practice. He held several patents on retaining wall and floor construction methods.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From October 10 to November 9, 1940, Inclusive

ADDITIONS TO MEMBERSHIP

Adams, John Kirk (Jun. '40), Little Hall-21, Cambridge, Mass.

Allen, Edwin Howe, Jr. (Jun. '40), Pioneer Hall, Univ. of Minnesota, Minneapolis, Minn.

Altenhofen, Matthew John (Jun. '40), Lt., Corps of Engrs., U.S. Army, Box 3031, Cristobal, Canal Zone.

Andersen, Mads Clarence (Jun. '40), Junior Engr., Dept. of State, International Boundary Comm., Farmers Bank Bldg., San Benito, Tex.

Bacci, Joseph Albert (Assoc. M. '40), Eng. Aide (Civ.), The Panama Canal, Municipal Eng. Div., Balboa Heights, C.Z.

Backman, Lester John (M. '40), Engr., The Ferro Concrete Constr. Co., 3d and Elm Sts. (Res., 3420 Berry Ave., Hyde Park), Cincinnati, Ohio.

Backus, Eugene Stephen (Jun. '40), Junior Engr. (Structural Steel Draftsman), Dept. of Public Works, 1415 Municipal Bldg., New York (Res., 690 President St., Brooklyn), N.Y.

Baldy, Neville William (Assoc. M. '40), Shire Hall, Yarra Junction, Victoria, Australia.

TOTAL MEMBERSHIP AS OF NOVEMBER 9, 1940	
Members................	5,643
Associate Members.......	6,472
Corporate Members....	12,115
Honorary Members......	36
Juniors................	4,221
Affiliates...............	70
Fellows................	1
Total..............	16,443

Bastian, Edward Daniel (Jun. '40), Junior Engr., RMC Constr. & Eng. Co., 101 Park Ave., New York, N.Y. (Res., 142 Catalpa Ave., Hackensack, N.J.)

Becker, Herbert David (Jun. '40), With Brewster Aeronautical Corp., Thirty-fourth St., Long Island City (Res., 417 St. Johns Pl., Brooklyn), N.Y.

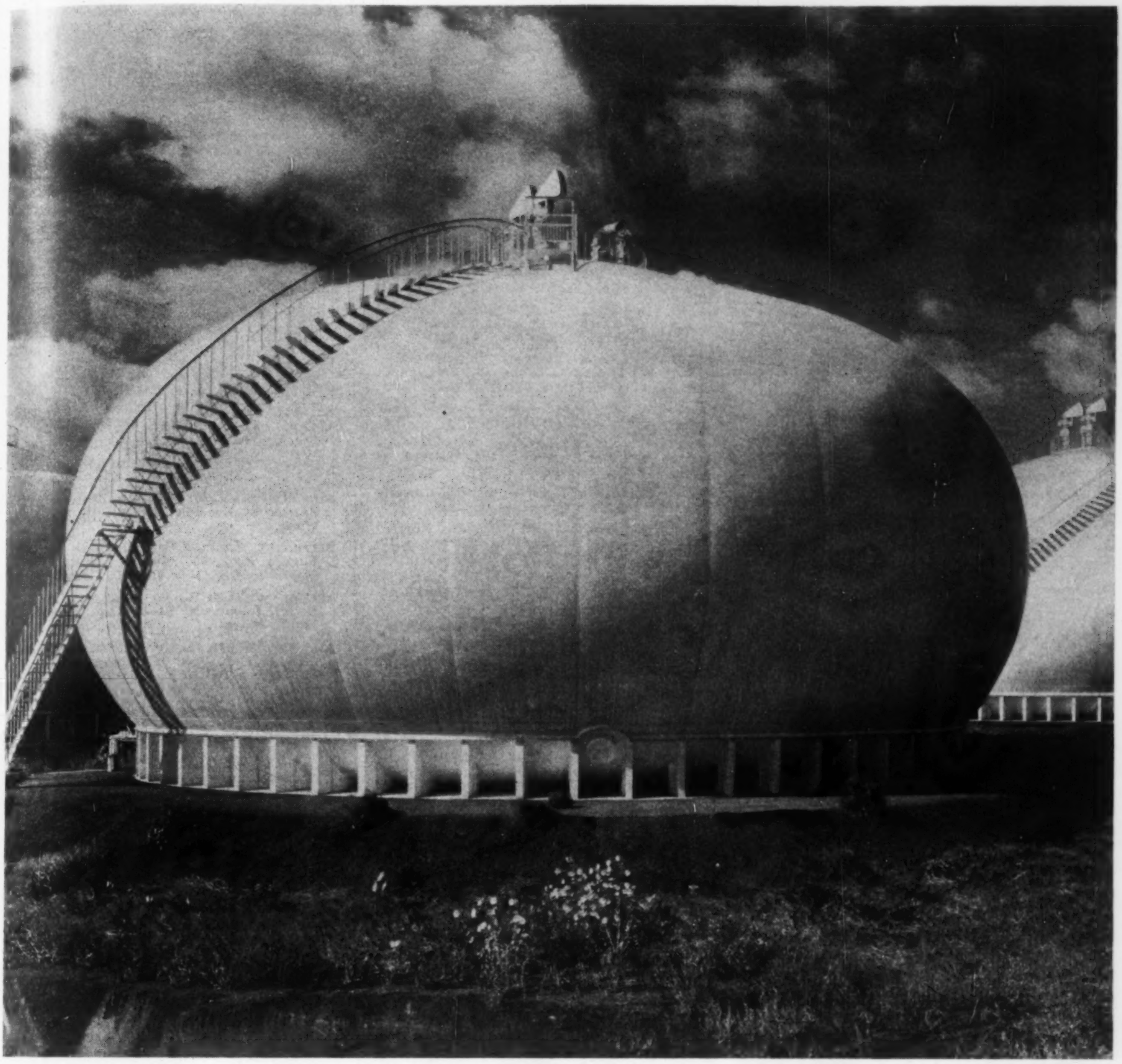
Bhoota, Baboobhai Vrajlal (Jun. '40), Graduate House, Mass. Inst. Tech., Cambridge, Mass.

Bilbiner, Tarik Ali (Jun. '40), San. Engr., Ministry of Public Health, School of Hygiene, Ankara, Turkey.

Blanks, Charles Preston, Jr. (Jun. '40), Junior San. Engr., TVA, Commercial Bank Bldg., Paris, Tenn.

Brown, Vern Melvin (Jun. '40), 725 Central Ave., Alameda, Calif.

Brunkhorst, George William (M. '40), Res. Engr., Consoer, Townsend & Quinlan, 211 West Wacker Drive, Chicago (Res., Hotel Fort Armstrong, Rock Island), Ill.



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Dallas................1485 Praetorian Bldg.
Houston................918 Richmond Ave.
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Caligiuri, Edward (Jun. '40), Student Engr., War Dept., U.S. Govt., 39 Whitehall St., New York (Res., 1533 East 23d St., Brooklyn), N.Y.

Carl, Kenneth John (Jun. '40), Field Engr., National Board of Fire Underwriters, 85 John St., New York (Res., 21 Porterfield Pl., Freeport), N.Y.

Carlino, Paul Peter (Jun. '40), Junior Engr., Jos. T. Ryerson & Son, Inc., 203 Westside Ave., Jersey City (Res., 6900 Tonnelle Ave., North Bergen), N.J.

Carns, Jack Milton (Jun. '40), Junior Engr., U.S. Geological Survey, Georgia School of Technology, Atlanta, Ga.

Center, Bernard Melin (Jun. '40), Eng. Aide, Const. Quartermasters, War Dept., Fort Dix, N.J. (Res., 490 East 23d St., Brooklyn, N.Y.)

Clark, William Rowe (Jun. '40), Student Engr., E. I. du Pont de Nemours & Co., Inc. (Res., 27 Shipley St.), Seaford, Del.

Cloud, Bruce Benjamin (Jun. '40), Junior Engr., H. B. Zachry Co., Laredo (Res., 106 Clutter Ave., San Antonio), Tex.

Coleman, James Hearst (M. '40), City Engr., City Hall, Greenwood, S.C.

Coleman, Richard Alester (Jun. '40), 24 Park Ave., Newport News, Va.

Crilly, Ira Benjamin (Jun. '40), Junior Engr., Const. Div., Quartermaster Corps, War Dept., Fort Myer, Va. (Res., 478 Prospect Ave., Hartford, Conn.)

Cummings, Robert Howard (Jun. '40), 1387 Dean St., Brooklyn, N.Y.

Dahl, Arve Hubert (Jun. '40), 2 Gorham St., Cambridge, Mass.

Daniels, Jonathan Graham (Jun. '40), With Chicago Bridge & Iron Co., 1305 West 105th St. (Res., 1624 West 107th St.), Chicago, Ill.

Diver, Ellsworth Noel (Jun. '40), Stress Analyst, The Glenn L. Martin Co., Middle River (Res., 2508 Ailsa Ave., Baltimore), Md.

Dixon, William James (Jun. '40), 1437 Elm St., Wilkinsburg, Pa.

Doman, Kendall Edwards (Jun. '40), Rodman, S. W. Hoyt, Jr., Co., Inc., 5 Railroad Ave., South Norwalk (Res., 69 Osborne Ave., East Norwalk), Conn.

Dorian, Raymond Benedict (Jun. '40), 2941 West Highland Blvd., Milwaukee, Wis.

Dornemann, Frederick Henry (Jun. '40), Junior Structural Engr., TVA, Knoxville, Tenn.

Doster, Thomas Edwin (Jun. '40), Instrumentman, State Highway Board, 109 East 13th Ave., Cordele, Ga.

Dreier, Douglas Emerit (Jun. '40), 512 East Healey St., Champaign, Ill.

Dunlap, Henry Reeves (Jun. '40), With Eng. Dept., Constr. Div., E. I. du Pont de Nemours & Co., Inc. (Res., 2609 Washington St.), Wilmington, Del.

Eberle, Richard Joseph (Jun. '40), Laboratory Asst., School of Eng., Yale Univ., Winchester Hall, 15 Prospect St. (Res., 79 Lake Pl.), New Haven, Conn.

Elder, Rex Alfred (Jun. '40), 205 Wilder Apartments, 10th and Jackson Sts., Corvallis, Ore.

Erickson, Frederick Kenneth (Jun. '40), Senior Eng. Aide, U.S. Engrs., Camp Tamgas, Annette Island, Ketchikan, Alaska.

Fennell, Earle James (Assoc. M. '40), Asst. Topographic Engr., U.S. Geological Survey, Rolla, Mo.

Filippone, Frank Anthony (Jun. '40), Graduate House, Mass. Inst. Tech., Cambridge, Mass.

Fink, Albert Adin (Jun. '40), Draftsman, State Highway Dept., Jackson St. (Res., 1133 East Culver), Phoenix, Ariz.

Firmage, David Allan (Jun. '40), 410 Memorial Drive, Cambridge, Mass.

Frail, Roger Grant (Jun. '40), Draftsman-Designer, Stone & Webster Eng. Corp., 49 Federal St. (Res., 316 Huntington Ave.), Boston, Mass.

Gewe, Robert Alexander (Jun. '40), Under Eng. Aide, State Div. of Highways, Pescadero (Res., Los Alamos), Calif.

Gillespie, Raymond Miller (Jun. '40), R.F.D. 4, Seneca, S.C.

Gilroy, Harold Bernard (Jun. '40), Insp., U.S. Bureau of Reclamation, Redding, Calif.

Glaser, August John (Jun. '40), Draftsman, The Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, N.Y. (Res., 1062 Westside Ave., Jersey City, N.J.)

Glass, Max (Jun. '40), Eng. Aide, War Dept., U.S. Army, Fort Dix, N.J. (Res., 718 Gates Ave., Brooklyn, N.Y.)

Goeke, Roscoe Henry (Jun. '40), 89 Trowbridge St., Cambridge, Mass.

Graham, Burleson (Jun. '40), Engr. (Instrumentman), Petty Gravity Surveys, Inc., Box 2061, San Antonio (Res., Tulia), Tex.

Graham, Jackson (Jun. '40), Capt., Corps of Engrs., U.S. Army, Fort Knox, Ky.

Graves, Douglas Evensen (Jun. '40), Engr., Boeing Aircraft Co. (Res., 2212 Roanoke), Seattle, Wash.

Greaves, Melvin J. (Jun. '39), Engr. Looper, Bethlehem Steel Co., Rankin Works, Rankin (Res., 7725 Brashear St., Pittsburgh), Pa.

Gregg, John Clark (Jun. '40), Asst. Instr. in Mechanics, Univ. of Delaware, Evans Hall (Res., 271 Orchard Rd.), Newark, Del.

Griffith, George Vintin (Jun. '40), Civ. Engr., B. H. Aires, 610 Maloney Bldg. (Res., 250 Woodhaven Drive), Pittsburgh, Pa.

Haas, Eugene Dunbar, Jr. (Jun. '40), 829 Logan Ave., New York, N.Y.

Hammar, Gustaf Leonard (Jun. '40), Materials Checker, State Highway Dept., 3461 First Ave., West, Dickinson, N.Dak.

Hammer, Vernon Benjamin (Jun. '40), Claverly 29, Harvard Univ., Cambridge, Mass.

Hanft, John Daniel (Jun. '40), Eng. Apprentice, P.R.R., 26 Exchange Pl., Jersey City, N.J. (Res., 1301 Hoe Ave., New York, N.Y.)

Hansen, Robert Joseph (Jun. '40), Asst. Civ. Engr., National Research Council, 2101 Constitution Ave., Washington, D.C.

Harrison, Leslie Dale (Jun. '40), Operating Engr., Quartermaster Corps, War Dept., Chanute Field, Rantoul (Res., 1102 West Green, Urbana), Ill.

Hawkins, Richard Owen (Jun. '40), Design Draftsman, Stone & Webster Eng. Corp., 72 Franklin St., Boston, Mass. (Res., 65 Riley Ave., Manchester, N.H.)

Hayes, Thomas Aloysius, Jr. (Jun. '40), Junior Hydrographic Engr., Board of Commerce and Navigation, 1060 Broad St., Newark (Res., 93 Wyoming Ave., South Orange), N.J.

Hess, James Kenneth (Jun. '40), Care, Louisiana Erecting Co., Box 97, Yukon, Fla.

Hickerson, Homer Churchill (Jun. '40), With U.S. Geological Survey, 6th and Broadway (Res., 708 South Barbee Way), Louisville, Ky.

Hintgen, George William (Jun. '40), Sanitarian, State Health Dept., City Hall, Palacios, Tex.

Hodges, Beverly Waugh (Jun. '40), With Boeing Aircraft Co. (Res., 5751 Thirty-third Ave., N.E.), Seattle, Wash.

Homack, Peter (Jun. '40), 108 Besler Ave., Cranford, N.J.

Hotes, Frederick Lorraine (Jun. '40), 407 South Dubuque, Iowa City, Iowa.

Hyman, Ernest Roy (Jun. '40), Asst. Engr., Trinidad Leaseholds, Ltd., Pointe à Pierre, Trinidad.

Jones, William Jasper, Jr. (Jun. '40), Rodman, C. M. St. P. & P.R.R., Milwaukee Depot, Butte, Mont.

Kennett, Thomas Charles (Jun. '40), Asst. Project Engr., Bridge Constr., State Highway Comm., Box 70 (Res., 515 East 3d), Seymour, Ind.

Klein, Frank (Jun. '40), Draftsman, Am. Bridge Co., Gary, Ind. (Res., 1526 George St., Chicago, Ill.)

Krocka, Fred Edward (Jun. '40), Junior Engr., Greeley & Hansen, Camp Peay, Tullahoma, Tenn. (Res., 1314 West Olive St., Milwaukee, Wis.)

Kyle, Bob Graves (Jun. '40), 2d Lt., U.S. Army, 69th Eng. Co. (Topographical) (Res., Fort Lewis Inn), Fort Lewis, Wash.

LaMasters, David John (Jun. '40), Sign Foreman, State Highway Dept., Deming, N.Mex.

Lane, Norman Edward (Jun. '40), Eng. Draftsman, TVA, Union Ave. (Res., 1406 Edgewood Ave.), Knoxville, Tenn.

Lee, Zur-Dau (Jun. '40), 241 Hinsdale House, Univ. of Michigan, Ann Arbor, Mich.

Liebig, John Orth, Jr. (Jun. '40), Structural Draftsman, Am. Bridge Co., Ft. of Warren St. (Res., 63 Maple Ave.), Trenton, N.J.

Lippard, Frank William (Jun. '40), Junior Insp., Ordnance Material, War Dept., 831 Enquirer Bldg. (Res., 6441 Grand Vista), Cincinnati, Ohio.

Lloyd, Earle Arthur (Assoc. M. '40), Zoning Engr., Regional Planning Comm., 205 South Broadway, Los Angeles, Calif.

Lockett, Harold Ben (Jun. '40), 6238 Columbia Ave., St. Louis, Mo.

Lomax, Claud Clifford, Jr. (Jun. '40), Research Asst., Univ. of Iowa, Hydraulics Laboratory (Res., 2 Melrose Circle), Iowa City, Iowa.

Longhi, Richard Lester (Jun. '40), Recorder, Dept. of Interior, U.S. Geological Survey, 226 Post Office Bldg., Jamaica (Res., 126 South 12th Ave., Mount Vernon), N.Y.

Luth, Louis Arthur (Jun. '40), With Russell & Axon, 4903 Delmar Ave. (Res., 4135 Flora Pl.), St. Louis, Mo.

Lyman, Charles Benton (Assoc. M. '40), Dist. Engr., The Lane Constr. Corp., 35 Colony St., Meriden, Conn. (Res., Claverack, N.Y.)

McCarty, Robert White (Jun. '40), Deck Officer, U.S. Coast and Geodetic Engr., "S.S. Oceanographer," Care, Postmaster, Norfolk, Va.

McKay, Wilbur Stewart, Jr. (Jun. '40), 4006 Bateman Ave., Baltimore, Md.

McMahon, Dennis James, Jr. (Jun. '40), Box 411, Wheaton, Minn.

Mandic, John (Jun. '40), Eng. Draftsman, U.S. Bureau of Reclamation, Box 494, Ephrata, Wash.

Marchant, Charles Gurdon (Jun. '40), With Buck & Buck, 650 Main St., Hartford (Res., 241 Alden Ave., New Haven), Conn.

Mason, William Ralph (Jun. '40), Graduate House, Room 426, Mass. Inst. Tech., Cambridge, Mass.

Mathews, Elmer Philip (Jun. '40), Instrumentman, E. I. du Pont de Nemours & Co., Inc., Millington (Res., 571 East McKellar, Memphis), Tenn.

Mitchell, Phil, II (Jun. '40), Labor Foreman, Walsh Constr. Co., Camp Edwards (Res., 25 Shore St.), Falmouth, Mass.

Morris, Grover Lee (Jun. '40), Instrumentman, State Highway Dept., Box 223, Hydro, Okla.

Morris, Robert Earl (Jun. '40), Draftsman, Chicago Bridge & Iron Co., 1500 Fiftieth St. (Res., 508 South 55th St.), Birmingham, Ala.

Neale, Lawrence Carlton (Jun. '40), 75 Main St., Cochituate, Mass.

Norman, James Carroll (Jun. '40), Black Hawk, S.Dak.

Odell, John Walter (Assoc. M. '40), Asst. Hydr. Engr., U.S. Geological Survey, 906 New Federal Bldg., St. Louis, Mo.

Olson, Walter Samuel (M. '40), Director, Div. of Drainage & Waters, State Dept. of Conservation, 6 State Office Bldg. (Res., 1649 Lincoln Ave.), St. Paul, Minn.

Olsson, Justus Axel (Jun. '40), Civ. Engr., U.S. Engrs., War Dept., Custom House, San Francisco (Res., 5831 Avenal Ave., Oakland), Calif.

Osthues, Henry Everett (Jun. '40), With Eng. Dept., City of Hartford, 550 Main St. (Res., 30 Annawan St.), Hartford, Conn.

Owen, Lewis Rees (M. '40), Civ. Engr., 307 Bedford St. (Res., 745 Tioga St.), Johnstown, Pa.

Pacheco Douglas, José (Jun. '40), Civ. Engr., Comision Nacional de Irrigacion, San Juan del Rio, Queretaro, Mexico.

Paradiso, Dominick Armando (Jun. '40), Layout Engr., Mahoney-Troast Co., Passaic (Res., 316 Old Bergen Rd., Jersey City), N.J.

Paul, Vivian Gaines, Jr. (Jun. '40), 2d Lt., 38th Infantry, U.S. Army, Fort Sill, Okla.

Paulson, Vernon Henry Arthur (Jun. '40), Draftsman, Special Eng., Babcock & Wilcox Co. (Res., 24 Tenth St.), Barberton, Ohio.

Perez, Henry Taylor (Jun. '40), With Bowery Savings Bank, 110 East 42d St., New York (Res., 36 Pondfield Rd., West, Bronxville), N.Y.

Perry, Thomas Henry, Jr. (Jun. '40), Draftsman, Dept. of Commerce, Bureau of Census, 1st and M Sts., N.E. (Res., 108 Third St., N.E.), Washington, D.C.

Phillippi, Stanley (Assoc. M. '40), Chf. Engr., Middle Rio Grande Conservancy Dist., Court House (Res., 315 Zearing Ave.), Albuquerque, N.Mex.

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Phillips, James Vernon, Jr. (Jun. '40), Engr. Insp., State Highway Dept., Box 420, Gaffney, S.C.

Plotts, Joseph Edward, Jr. (Jun. '40), Asst. Eng. Aide, Maps and Surveys Div., TVA, Box 92, Waverly, Tenn.

Pokrajac, Nick (Jun. '40), Junior Highway Engr., 126 East Ash St., Springfield (Res., 1409 Nineteenth St., East Moline), Ill.

Porteous, Alfred John (Jun. '40), 1045 West 35th St., Indianapolis, Ind.

Prince, Harry Clayton (Jun. '40), Detailer-Draftsman, Am. Bridge Co. (Res., 434 Taft St.), Gary, Ind.

Putt, Gladyn Hollis (Jun. '40), Draftsman, Douglas Aircraft Co. (Res., 1047 Grant St.), Santa Monica, Calif.

Ralston, Thomas Eugene (Jun. '40), Asst. Supervisor-Track, P.R.R., Wellsville, Ohio. (Res., 1325 Singer Pl., Wilkinsburg, Pa.)

Rennie, Thomas John (Jun. '40), Asst. Engr., City Engrs. Office, City Hall (Res., 4904 Baronne St.), New Orleans, La.

Riggs, Henry Chiles (Jun. '40), Recorder, U.S. Geological Survey, 406 Federal Bldg., Tacoma, Wash.

Ristau, Kenneth Eugene (Jun. '40), Asst. Civ. Engr., TVA, 700 Union Bldg. (Res., 231 Highland Drive), Knoxville, Tenn.

Roberts, Elbert (Jun. '40), Structural Engr., Boeing Aircraft Co., 200 West Michigan (Res., 1800 McClellan), Seattle, Wash.

Robinson, Charles Urban (Jun. '40), Junior Asst. Engr., State Road Comm., 1340 Wilson St. (Res., 1521 Jackson St.), Charleston, W.Va.

Roy, Joseph Albert (Jun. '40), Sales Engr., Old Colony Tar Co., Inc., South Water St., New Bedford (Res., 84 Wing Rd., Acushnet), Mass.

Rummel, Edward Frank (Assoc. M. '40), Designing Engr., Whitman, Requardt & Smith, Charles and Biddle Sts. (Res., 18 North Ellamont St.), Baltimore, Md.

Russ, Myron Hamilton (Jun. '40), Junior Engr., U.S. Engr. Office (Res., 1152 South Norfolk), Tulsa, Okla.

Ryan, Francis Robert (Jun. '40), Junior Engr., Southern California Gas Co., 810 South Flower (Res., 226 North Arden Blvd.), Los Angeles, Calif.

Schaeffer, James Jonas (Jun. '40), Engr., Rochester & Pittsburgh Coal Co., Church St., Indiana (Res., 814 East Mahoning, Punxsutawney), Pa.

Schlafly, Roy Karl (Jun. '40), Draftsman, The Standard Oil Co. (Ohio), Drawer H (Res., Y.M.C.A.), Lima, Ohio.

Schrader, Robert Kenneth (Jun . '40), 410 Stewart Ave., Ithaca, N.Y.

Schultz, Thomas Byron (Jun. '40), 625 Main Street, Brookings, S.Dak.

Schumm, Louis Worley, Jr. (Jun. '40), Aluminum Club, Freeport Rd., New Kensington, Pa.

Seale, Allen Thomas Franklin (Assoc. M. '40), Res. Engr., State Highway Dept., Lufkin, Tex.

Shackleton, Allen Roy (Jun. '40), 6253 Sheridan Rd., Apt. 22, Chicago, Ill.

Sharkey, Thomas Bernard (Jun. '40), Junior Eng. Aide, TVA, Kentucky Dam, Gilbertsville, Ky.

Sheppard, Joseph Wagoner (Jun. '40), 3822 North Western Parkway, Louisville, Ky.

Skiba, John (Jun. '40), Asst. Eng. Draftsman, Navy Dept., Navy Yard, Brooklyn (Res., 28–28 Twenty-ninth St., Long Island City), N.Y.

Smith, Cameron MacPherson (Jun. '40), Box 2188, Yale Station, New Haven, Conn.

Smith, George Ernest (M. '40), Engr. of Location, State Highway Dept., 165 Capitol Ave., Hartford (Res., 6 Treadwell Ave., New Milford), Conn.

Smith, Gordon Burr (Jun. '40), Nav. Eng. Aide, TVA, 401 Arnstein Bldg. (Res., 1628 Yale Ave.), Knoxville, Tenn.

Snyder, Millard Purnell (Jun. '40), Field Engr., United Gas Pipe Line Co., Box 1407 (Res., 902 Delaware St.), Shreveport, La.

Somson, Alfred Spencer (Jun. '40), Draftsman, Carroll McCreary Co., Inc., 46–81 Metropolitan Ave., Brooklyn (Res., 1789 Davidson Ave., New York), N.Y.

Spaw, Louis David, Jr. (Jun. '40), Junior Engr., Humble Oil & Refining Co. (Res., 141 Brace St.), Houston, Tex.

Standke, William Frederick, Jr. (Jun. '40), Draftsman, United Gas Pipe Line Co., United Gas Bldg. (Res., Y.M.C.A.), Shreveport, La.

Steffens, Louis Arthur (Jun. '40), Asst. Eng. Aide, Maps and Surveys Div., TVA, 705 Pound Bldg., Chattanooga, Tenn.

Stinson, Spencer Davis (Jun. '40), Detailer, Am. Bridge Co. (Res., 210 Pine St.), Ambridge, Pa.

Strauss, Max William (Jun. '40), Eng. Draftsman, Scientific Section, C. and R. M-60, Navy Yard (Res., 5703 New Utrecht Ave.), Brooklyn, N.Y.

Sullivan, Charles Francis (Jun. '40), Central St., Millville, Mass.

Sussman, Gabriel (Jun. '40), Chainman, Office of Chf. Engr., P.R.R., Pennsylvania Station, New York (Res., 2064 East 2d St., Brooklyn), N.Y.

Tatarian, Shavarsh Myron (Jun. '40), 2314 Leavenworth St., San Francisco, Calif.

Thompson, Charles Everett (Jun. '40), Care, Petty Gravity Surveys, Inc., Box 378, McComb, Miss.

Tompkins, William Fraser, Jr. (Jun. '40), Care, George E. Hamilton, Stone Ridge, Bethesda, Md.

Topping, Alanson Dall (Jun. '40), With Am. Bridge Co. (Res., 532 Park Rd.), Ambridge, Pa.

Turnbell, Richard Henry (Jun. '40), Rodman, Nickel Plate R.R., Div. Engrs. Office, Conneaut, Ohio. (Res., 779 Deer St., Dunkirk, N.Y.)

Tye, Soo-Cheong (Jun. '40), 616 East Daniel St., Apt. 3, Champaign, Ill.

Vebber, Richard Jay (Jun. '40), Asst. Eng. Aide, TVA, Blount National Bank Bldg., Maryville, Tenn.

Versaw, Herbert Dean (Jun. '40), Draftsman, Babcock & Wilcox Co. (Res., 103 Seventh St., N.W.), Barberton, Ohio.

Wabashaw, Cecil Charles (Jun. '40), Trail Locator, CCC, Indian Div., Window Rock, Ariz.

Waring, Edward Holman (Jun. '40), Rodman, New York Central R.R., 370 West Broad St. (Res., 275 Acton Rd.), Columbus, Ohio.

Warren, Vernon James (Jun. '40), Research Asst., State Highway Dept., 510 State Office Bldg., Salem (Res., 3261 Jackson St., Corvallis), Ore.

Weedin, Harmer Allen (Jun. '40), Instr., Civ. Eng., Bucknell Univ., Lewisburg, Pa.

Westphal, Carl Wells (Jun. '40), Asst. Insp., State Highway Dept., Box 203, Fordyce (Res., 2425 West 12th St., Little Rock), Ark.

Wilcox, Willa Ruth (Miss) (Jun. '40), Checker, State Highway Dept., Box 302, R.F.D. 3, Olympia, Wash.

Willey, Gordon Brockway (Jun. '40), Draftsman and Engr., State Highway Dept., State St., Montpelier (Res., 8 Union St., Orleans), Vt.

Willis, Merton Joseph (Jun. '40), 524 Dryden Rd., Ithaca, N.Y.

Wiltz, Ernest Raymond (Jun. '40), Junior Engr., City Engrs. Office, City Hall (Res., 812 Hamilton Blvd.), Peoria, Ill.

Woxland, Maurice (Jun. '40), 225 Harvard St., S.E., Minneapolis, Minn.

Wrenn, Lewis Mitchell (Assoc. M. '40), City Engr., 52 East Pike St. (Res., 11 Niagara Ave.), Pontiac, Mich.

Yates, Thomas Jackson (Jun. '40), Engr., Constr. Dept., National Distillers Products Corp., 7th and Bernheim Lane, Louisville, Ky. (Res., 325 Ohio Ave., Jeffersonville, Ind.)

Ziegler, William Edward (Jun. '40), Eng. Clerk, Siems, Drake, Puget Sound, 2929 Sixteenth, S.W. (Res., 1903 North 46th), Seattle, Wash.

MEMBERSHIP TRANSFERS

Baer, Willard Arthur (Jun. '35; Assoc. M. '40), Junior Engr. (Civ.), U.S. Engr. Office, Custom House, Nashville, Tenn.

Bell, Mace Hudson (Jun. '30; Assoc. M. '40), Dist. Engr., Am. Inst. of Steel Constr., Inc., 506 Stern Bldg., New Orleans, La.

Berkey, Charles Peter (M. '29; Hon. M. '40), Newberry Prof. Emeritus of Geology, Columbia Univ., New York, N.Y.

Carlson, Frank Bowers (Jun. '35; Assoc. M. '40), Associate Engr., U.S. War Dept., Corps of Army Engrs., 751 South Figueroa St., Los Angeles (Res., 1636 South Meridian St., Alhambra), Calif.

Coakley, Edward Albert (Jun. '34; Assoc. M. '40), Deputy Chf. Archt., FHA, 90 Church St., New York (Res., 35–35 Seventy-fifth St., Jackson Heights), N.Y.

Deignan, John Eugene (Jun. '26; Assoc. M. '31; M. '40), Engr., U.S. Engr. Office, Chamber of Commerce Bldg., Pittsburgh, Pa.

Fenkell, George Harrison (Jun. '99; Assoc. M. '02; M. '09; Hon. M. '40), Cons. Engr., 12266 Tuller Ave., Detroit, Mich.

Galloway, John Debo (M. '05; Hon. M. '40), Cons. Engr., 1 Montgomery St., San Francisco, Calif.

Getz, Murray Austin (Jun. '34; Assoc. M. '40), Junior Civ. Engr., State Forest Service, Indian Trail State Forest, Salem, Mo.

Giles, John Henry Latham (Jun. '29; Assoc. M. '40), Associate San. Engr., State Dept. of Health, 165 Capitol Ave., Hartford (Res., 127 Grove St., Elmwood), Conn.

Haven, Robert Cooper, Jr. (Jun. '32; Assoc. M. '40), Asst. Engr., U.S. Bureau of Reclamation, 339 Federal Bldg., Salt Lake City, Utah.

Heard, William Lee (Jun. '28; Assoc. M. '40), Area Engr., SCS (Res., 553 Iowa Ave.), New Albany, Miss.

Jonah, Frank Gilbert (M. '03; Hon. M. '40), Chf. Engr., St.L.S.F. Ry., 726 Frisco Bldg., St. Louis, Mo.

Jones, James Allen (Jun. '39; Assoc. M. '40), Asst. Gen. Supt., Malaria Control, WPA (Res., 100½ George St.), Greenwood, Miss.

Lowry, Robert Lee, Jr. (Assoc. M. '34; M. '40), Hydr. Engr., National Resources Planning Board, Pecos River Joint Investigation, Suite 10, City Hall (Res., 1204 North Kentucky Ave.), Roswell, N.Mex.

Morang, Clarence Nolan (Jun. '36; Assoc. M. '40), Regional Hydrologist, Dept. of Agriculture, Flood Control Surveys, Allegheny Forest Experiment Station, 3437 Woodland Ave., Philadelphia, Pa.

Murdichian, Karmy Karnig (Jun. '34; Assoc. M. '40), Civ. Engr., 458 Seventy-seventh St., Brooklyn, N.Y.

Orbacz, Stanley Edward (Jun. '30; Assoc. M. '40), Junior Engr., U.S. Engr. Office, War Dept., 332 Post Office Bldg. (Res., 44 Oaklee Village), Baltimore, Md.

Potter, Seymour Austin, Jr. (Jun. '34; Assoc. M. '40), Asst. to Const. Quartermaster, U.S. Army, Fort Hancock (Res., 11 Forman Pl., Fairhaven), N.J.

Reynolds, George Lawrence (Jun. '30; Assoc. M. '40), Asst. Civ. Engr., U.S. Dept. of Agriculture, Shasta National Forest, Forest Service, Mount Shasta, Calif.

Sanders, William Leander, Jr. (Jun. '33; Assoc. M. '40), Office Mgr., L.A.&R.S. Crow, 4756 Valley Blvd. (Res., 514 West 52d Pl.), Los Angeles, Calif.

Scholer, Eben Ellsworth (Assoc. M. '29; M. '40), Highway Engr., Shell Oil Co., Inc., Shell Bldg., St. Louis, Mo.

Stanley, Howard Burton (Jun. '31; Assoc. M. '40), Junior Highway Engr., U.S. Public Roads Administration, Box 3900 (Res., 1616 North East 48th Ave.), Portland, Ore.

Thomson, Reginald Heber (M. '03; Hon. M. '40), Cons. Engr., 1636 Thirty-fourth Ave., Seattle, Wash.

Treece, Clyde Charles (Jun. '38; Assoc. M, '40), Designer, State Highway Dept., Highway Dept. Bldg., State Capitol (Res., 1020 West 5th St.), Little Rock, Ark.

Weinstein, Henry (Jun. '31; Assoc. M. '40), Junior Engr., U.S. Engrs., Box 59 (Res., 4401 South 2d St.), Louisville, Ky.

REINSTATEMENTS

Boone, Wesley Williams, Assoc. M., reinstated Oct. 23, 1940.

Ciampa, Felix Anthony, Assoc. M., reinstated Oct. 31, 1940.

Lusk, Charles Benton, Jun., reinstated Oct. 25, 1940.

Rose, Howard Dewitt, Assoc. M., reinstated Oct. 9, 1940.

Salmon, Richard, Assoc. M., reinstated Oct. 10, 1940.

RESIGNATIONS

Bogart, John Luyster, M., resigned Oct. 15, 1940.

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Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

December 1, 1940

Number 12

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

Ballard, James Irving (Assoc. M.), San Francisco, Calif. (Age 40) (Claims RCA 5.5 RCM 5.6) April 1935 to date Editor, *Western Construction News.*

Barnes, Stephenson Barton (Assoc. M.), North Hollywood, Calif. (Age 40) (Claims RCA 3.6 RCM 14.0) Oct. 1933 to date Cons. Structural Engr.

Bauer, Sol A., Cleveland, Ohio. (Age 42) (Claims RCA 0.5 RCM 18.4) Oct. 1925 to date Owner, Bauer Surveys Co., being Engr. on surveying and allied engineering work, etc.

Bones, John William, Harlingen, Tex. (Age 45) (Claims RCA 14.6 RCM 6.7) Dec. 1935 to date with WPA, as Res. Engr. Inspector, Engr. Examiner, Special Asst. to Asst. Administrator, and (since July 1939) Project Engr.

Boone, Wesley Williams (Assoc. M.), Memphis, Tenn. (Age 54) (Claims RC 29.9) 1921 to date Pres., Boone and Wester, Inc., Constr. Engrs. and Contrs.

Brooks, George Raymond, Clarksburg, W.Va. (Age 45) (Claims RCA 5.3 RCM 5.5) April 1940 to date City Engr., Clarksburg, W.Va.; previously Designer, Palace Furniture Co., Clarksburg; Constr. Supt., R. W. Fimple Co., Fairmont, W.Va.; Chf. Engr. and Dist. Director, WPA, Ohio.

Cambell, Chester Wendell (Assoc. M.) Staten Island, N.Y. (Age 38). (Claims RCA 7.9 RCM 6.5) March 1938 to date Borough Supt., Dept. of Housing and Buildings, New York City; previously Examining Engr., PWA in Washington and New York City.

Evans, Daniel Williams, Arlington, Va. (Age 41) (Claims RCA 5.0 RCM 10.1) Sept. 1938 to date San. Engr. (Engr. P-4), FSA, U.S. Dept. of Agriculture, Washington, D.C.; previously Public Health Engr. (Associate P-3), RA; with Pennsylvania Dept. of Health as Asst. Engr., and Acting Dist. Engr., Flood Relief, Greensburg, Pa.

Genter, Albert Legrand, Baltimore, Md. (Age 59) (Claims RC 34.0 D 31.7) 1936 to date Cons. Engr.; previously at Baltimore (Md.) sewage-treatment plant on private research in sanitary engineering, etc.

Hand, George Washington (Assoc. M.), Chicago, Ill. (Age 57) (Claims RCA 7.4 RCM 26.3) April 1903 to date with Chicago & North Western Ry., as Tapeman, Rodman, Instrumentman, Asst. Engr., Valuation Engr., Corporate Engr., and (since March 1920) Asst. to Pres. on operation and management.

Herrick, Donald Frederick, Charlevoix, Mich. (Age 41) (Claims RCM 14.6) June 1938 to date City Supt.; previously Res. Engr. Inspector, PWA, Detroit, Mich.; Supervisor of Operations, WPA, Kalamazoo, Mich.

Higgins, Nathan Bert, Baltimore, Md. (Age 55) (Claims RCM 26.5) May 1914 to date with Pennsylvania Water & Power Co., and Safe Harbor Water Power Corporation, in various capacities, at present as Chf. Engr.

Holland, Paul Leach (Assoc. M.), Baltimore, Md. (Age 53) (Claims RCA 9.6 RCM 14.6) April 1931 to date Chf. Engr., Public Service Comm. of Maryland.

Kent, Samuel, Brooklyn, N.Y. (Age 47) (Claims RCA 1.0 RCM 24.5) 1915 to 1925 (except six months in 1918 with F. A. Officers' Training School, U.S. Army) and 1933 to date Engr. and Estimator with P. J. Carlin Constr. Co., Engrs. and Contrs., New York City.

Lefever, Kenneth Winans (Assoc. M.), Little Rock, Ark. (Age 43) (Claims RCA 7.3 RCM 8.3) June 1935 to date in private practice, since Jan. 1938 being associated with D. A. MacCrea and M. Z. Bair.

MacKrell, Edwin Allan, Brooklyn, N.Y. (Age 52) (Claims RCA 11.0 RCM 5.8) May 1938 to date Engr., Wickwire Spencer Steel Co., New York City; previously with Bethlehem Steel Corporation.

Moore, Vincent Bayard, Ogden, Utah. (Age 44) (Claims RCA 2.6 RCM 14.7) Feb. 1933 to date (except April 1937 to June 1938 unemployed) with U.S. Army as student and on CCC work and since July 1938 with Constr. Quartermaster, War Dept., in various capacities; at present Major, Air Reserve Corps.

Oakley, Thomas Denton (Assoc. M.), Memphis, Tenn. (Age 43) (Claims RCA 5.5 RCM 7.4) Oct. 1930 to date with U.S. Engr. Office (except Sept. 1931 to Oct. 1932 graduate student) Inspector, Asst. Engr., and (since June 1935) Associate Engr.

Park, Charles Abraham (Assoc. M.), Washington, D.C. (Age 58) (Claims RCA 3.0 RCM 29.7) July 1939 to date Capt., U.S. Coast Guard; previously with U.S. Lighthouse Service successively as Asst. (Prin.) to Officer in Charge, and Supt. in charge of 11th Lighthouse Dist., Detroit, Mich., Chf. Engr., and Deputy Commr. of Lighthouses.

Plummer, Harry Custer (Assoc. M.), Washington, D.C. (Age 43) (Claims RCM 11.8) June 1937 to date with Structural Clay Products Institute as Chf. Engr. and Director of Eng. and Research; previously Chf. Engr., Brick Manufacturers Association.

Quade, Maurice Northrop (Assoc. M.), New York City. (Age 40) (Claims RCA 5.5 RCM 6.9) July 1937 to date Engr. with Parsons, Klapp, Brinckerhoff & Douglas, Cons. Engrs.; previously Asst. Engr. and Designer with Parsons, Klapp, Brinckerhoff & Douglas, and Waddell & Hardesty.

Severud, Fred Nicholas (Assoc. M.), Larchmont, N.Y. (Age 41) (Claims RCA 1.0 RCM 13.7) Oct. 1928 to date in private practice, until May 1932 as partner, Ruderman & Severud, Structural Consultants to architects and since May 1932 as Fred N. Severud, Cons. Engr.

Simpson, Willard Eastman (Assoc. M.), San Antonio, Tex. (Age 57) (Claims RCM 29.2) 1911 to date Cons. Engr., under firm name, W. E. Simpson Co.

Sparks, Benjamin Franklin, Escanaba, Mich. (Age 55) (Claims RCA 7.0 RCM 25.0) 1933 to date Upper Peninsula Engr., Michigan State Highway Dept.

Wilson, Francis Jennings, Washington, D.C. (Age 41) (Claims RCA 6.7 RCM 10.0) June 1922 to March 1927 2nd Lieut., March 1927 to Aug. 1935 1st Lieut., Aug. 1935 to July 1940 Capt., and since July 1940 Major, Corps of Engrs., U.S. Army.

APPLYING FOR ASSOCIATE MEMBER

Allen, James Frederick, Clarksburg, W.Va. (Age 29) (Claims RCM 4.5) June 1940 to date Constr. Engr., City of Clarksburg; previously Supt. of all construction for Clarksburg (W.Va.) Excavating Co.; Rodman, Baltimore and Ohio R.R.

Arne, I Christian (Junior), Chicago, Ill. (Age 32) (Claims RCA 1.9) Dec. 1936 to date with Chicago Bridge & Iron Co., Erection Dept.; previously Jun. Highway Engr., Illinois State Highway Dept., Cook County.

Brooks, Houston Frederick, Jr., Waxahachie, Tex. (Age 31) (Claims RCA 4.2 RCM 1.0) June 1929–Sept. 1930, Dec. 1931–Nov. 1934, Feb. 1935–Sept. 1937 and June 1940 to date with Texas Highway Dept., as Chainman, Asst. Office Engr., Instrumentman, Office Engr., Bridge Inspector, and (since June 1940) Jun. Inspector; in the interim with Texas Highway Planning Survey, Austin, as Railroad Grade Crossing Study Clerk, and Draftsman.

Chilcote, William Leonard, Baltimore, Md. (Age 34) (Claims RCA 2.6 RCM 8.9) May 1925 to date with Dept. of Public Works, Baltimore, Md., as Jun. Draftsman, Senior Draftsman, Asst. Engr., Asst. Civ. Engr., and (since April 1940) Associate Civ. Engr., Bridge Div., Bureau of Highways.

Christiani, Henning Oldenburg (Junior), New York City. (Age 29) (Claims RCA 2.0 RCM 1.3) Feb. to March 1936 and July 1938 to May 1940 Engr., and May 1940 to date Asst. Gen. Mgr., Christiani & Nielsen, Civ. Engrs. and Contrs.; in the interim Special Bridge Engr. for New Haven, Conn.; Engr., New York World's Fair 1939, Inc.; Engr. with Madigan & Hyland, Cons. Engrs., New York City.

Clarridge, Charles Evans (Junior), Potsdam, N.Y. (Age 32) (Claims RCA 1.0) Sept. 1931 to date (including summer sessions 1936–1938), Instructor, Civ. Eng. Dept., Clarkson Coll. of Technology.

Currie, David Hume, San Bernardino, Calif. (Age 28) (Claims RCA 4.8 RCM 1.5) June 1933 to date with Currie Eng. Co., as Draftsman.

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DADING, CHARLES HENRY, Schenectady, N.Y. (Age 57) (Claims RCA 27.8) 1931 to date Constr. Engr. with Public Buildings Administration, FWA.

ECKLE, JOHN NICHOLAS, New Haven, Conn. (Age 52) (Claims RCA 14.0 RCM 0.5) Feb. 1920 to 1927 Instructor, Dept. of Civ. Eng., and 1927 to date Asst. Prof., Dept. of Eng. Drawing, Yale Univ.

ELIASSEN, ROLF, New York City. (Age 29) (Claims RCA 3.2) Aug. 1940 to date Associate Prof. of San. Eng., New York Univ.; previously Asst. Prof. of Civ. Eng., Armour Inst. of Technology, Chicago, Ill.; San. Engr., The Dorr Co., Inc., New York City.; Jun. San. Engr. with J. N. Chester, Engrs., Pittsburgh, Pa.

FORNEROD, MARCEL FRANCIS, Scarsdale, N.Y. (Age 37) (Claims RCA 5.4 RCM 2.5) Feb. 1937 to date Designer and Estimator, Borsari Tank Corporation of America, New York City; previously in private practice as Cons. Engr., Zurich, Switzerland.

GRANT, BURTON SMITH, Los Angeles, Calif. (Age 36) (Claims RCA 6.9 RCM 2 8) June 1925 to June 1929 Topographical Draftsman, June 1929 to March 1938 Jun. Civ. Engr., and April 1938 to date Asst. Civ. Engr., Bureau of Water Works & Supply.

GRAY, GEORGE LUTHER, Allentown, Pa. (Age 33) (Claims RCA 3.0 RCM 1.0) Jan. 1931 to date Estimator and Designer, Bethlehem Steel Co., Fabricated Steel Construction.

GREEN, STERLING STEFFEN (Junior), Los Angeles, Calif. (Age 31) (Claims RCA 7.8) Dec. 1930 to date with Dept. of Water and Power, Bureau of Water-Works and Supply as Laborer (Special), Chainman, Laboratory Technician, and (since Jan. 1933) Materials Testing Engr.

HANDS, GLENN ELBERT, Kansas City, Mo. (Age 31) (Claims RCA 2.3 RCM 2.9) July 1936 to date with Burns & McDonnell Eng. Co.; previously Water and Light Supt., City of Marion, Kans.

HIEGL, GEORGE, JR. (Junior), Philadelphia, Pa. (Age 31) (Claims RCA 4.5) May 1934 to date with Kolyn Constr. Co., Trenton, N.J., as Timekeeper, Constr. Engr., and (since June 1938) Supt. of Constr.

IRWIN, RAYMOND LEWIS (Junior), Cincinnati, Ohio. (Age 32) (Claims RCA 2.9) Oct. 1935 to date with U.S. Engr. Office, as Draftsman, Jun. Engr., Asst. Engr., and (since Oct. 1940) Associate Engr.

ISAAK, ELMER BRAMWELL, New York City. (Age 28) (Claims RCA 2.8) June 1935 to date Civ. Engr. with Madigan-Hyland, Cons. Engrs., New York City, and Long Island City, N.Y.

JANVRIN, PHILIP EUGENE (Junior), Champaign, Ill. (Age 29) (Claims RCA 2.0) July 1936 to June 1937 2nd Lieut., 1st Engrs., and Sept. 1940 to date 1st Lieut., Engr. Reserve, Corps of Engrs., U.S. Army; in the interim Civ. Engr., Standard Oil Company of Venezuela; previously Rodman, U.S. Engrs., Concord, N.H.

KNOLL, CARL ALVIN (Junior), Boulder City, Nev. (Age 32) (Claims RCA 3.0) May 1933 to Jan. 1938 and Feb. 1939 to date with Metropolitan Water Dist. of So. Calif., Los Angeles, Calif., as Rodman, Recorder, Foreman, Senior Constr. Inspector, etc.

KOEHLER, ELMO HENRY, San Benito, Tex. (Age 38) (Claims RCA 9.2) Oct. 1936 to date Senior Draftsman, International Boundary Comm., United States and Mexico; previously Draftsman and Asst. Right-of-way Engr., Harris County (Tex.).

KOEHM, EDWARD (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 2.9 RCM 7.4) Aug. 1930 to date with U.S. Engr. Dept., as Jun. Engr., Asst. Engr., and (since Jan. 1939) Associate Engr. and Engr.

LETHERBURY, JOHN BOYD (Junior), Philadelphia, Pa. (Age 32) (Claims RCA 4.5 RCM 0.6) Oct. 1934 to date Hull Structural Draftsman, New York Shipbuilding Corporation, Camden, N.J.

LEWIS, DOUGLAS DUANE, Knoxville, Tenn. (Age 37 (Claims RCA 9.9) March 1929 to date with U.S. Geological Survey as Jun. Engr., Asst. Engr., and (since June 1940) Associate Engr.

LOGAN, GLEN EARNEST (Junior), San Francisco, Calif. (Age 32) (Claims RCA 2.0) July 1940 to date Structural Draftsman for A. W. Earl; previously Senior Eng. Draftsman, U.S. Coast Guard; Engr. and Draftsman for George A. Kneese, Civ. Engr., Redwood City, Calif.; traveling; Chf. of Hydrographic Party for San Francisco Exposition Fill, under U.S. Engr. Dept.; Jun. Office Engr., RA.

MASK, WALTER SHARMAN (Junior), New Orleans La. (Age 32) (Claims RCA 2.4) Aug. 1929 to date with U.S. Engrs., as Inspector, Eng. Aide, and (since Oct. 1938) Jun. Engr., Eng. Div.

NICHOLS, KENNETH DAVID (Junior), West Point, N.Y. (Age 33) (Claims RCA 5.3 RCM 1.5) Sept. 1929 to date with Corps of Engrs., U.S. Army as 2d Lieut., 1st Lieut., and (since June 1939) Capt.

NUTE, JOHN WARREN (Junior), Santa Clara, Calif. (Age 32) (Claims RCA 4.3 RCM 3.7) Sept. 1938 to date Deputy County Engr., Santa Clara County, San Jose, Calif.; previously with Eng. Dept., U.S. Forest Service, San Francisco, Calif.

OSBORN, JOHN RICHARD (Junior), College Station, Tex. (Age 32) (Claims RCA 1.2) Sept. 1937 to Sept. 1938 Graduate Asst. and graduate student, and Sept. 1939 to date Instructor in Civ. Eng., Agricultural & Mechanical Coll. of Texas; in the interim Instructor and Testing Engr., Dept. of Civ. Eng., Colorado State Coll., Ft. Collins, Colo.; previously with Indiana Board of Health, and Indiana Dept. of Conservation, Div. of Eng., both of Indianapolis, Ind.

PARKINSON, CLYDE PHILIP (Junior), Albany, N.Y. (Age 29) (Claims RCA 3.9) Aug. 1936 to March 1940 Jun. Hydr. Engr., and April 1940 to date Asst. Hydr. Engr., U.S. Geological Survey; previously Asst. Project Engr., State Highway Comm. of Indiana.

PIPER, JAMES DICKINSON (Junior), Dallas, Tex. (Age 28) (Claims RCA 1.9 RCM 3.6) April 1937 to date Structural Field Engr., Portland Cement Association; previously Architectural Engr., State of Oklahoma.

SANFORD, JOHN GRAEME, Vincennes, Ind. (Age 31) (Claims RCA 6.6) May 1934 to date with Indiana State Highway Comm. as Project Engr., and (since April 1940) Dist. Office Engr., Vincennes Dist.

VALENTINE, WILLIAM JOSEPH, Charleston, S.C. (Age 28) (Claims RCA 2.9) Aug. 1939 to date Asst. Development Engr., South Carolina Public Service Authority; previously Research Engr. and Planning Technician, State Planning Board; Project Supervisor of studies of parks, etc., for South Carolina, under National Park Service.

WALKER, JAMES MATT (Junior), Fort Worth, Tex. (Age 32) (Claims RCA 6.7) June 1929 to date with Engr.'s Dept., Tarrant County, Tex., as Computer, Earthwork Dept., Rodman, Asst. Instrumentman, Chf. of Computing Dept., and (since July 1937) Office Engr.

WALL, HARRY BOYKIN, Little Rock, Ark. (Age 37) (Claims RCA 13.1) July 1925 to May 1936 and Sept. 1936 to date with Arkansas State Highway Comm., as Instrumentman, Res. Engr., Dist. Materials Engr., Inspector, and (since June 1937) Field Materials Engr.

WALTHER, CARL HUGO (Junior), Washington, D.C. (Age 29) (Claims RCA 1.7) Sept. 1939 to date Instructor in Civ. Eng., The George Washington Univ.; previously Detailing Draftsman, Checker, and Asst. Squad Leader, Bethlehem Steel Co., Pottstown, Pa.; Designing Draftsman with Herman F. Doeleman, Cons. Structural Engr., Baltimore, Md.; State Materials Engr., WPA of Maryland.

WHITEHEAD, WILLIAM JAMES (Junior), Arlington, Va. (Age 32) (Claims RCA 7.4 RCM 1.6) March to June 1939 Asst. Structural Engr., and Aug. 1939 to date Asst. Civ. Engr., Civ. Eng. Sec., Office of the Quartermaster General, Constr. Div., Washington, D.C.; previously with State Highway Dept., Cleveland, Ohio, as Field Engr., Asst. Engr., and Res. Dist. Deputy-Director.

WIMER, WALTER LLOYD, Butler, Pa. (Age 34) (Claims RCA 11.5) June 1929 to date with Harry Wimer, Inc., Contr., and on work for others as Office Engr., Eng. Consultant, Chf. Engr., etc.

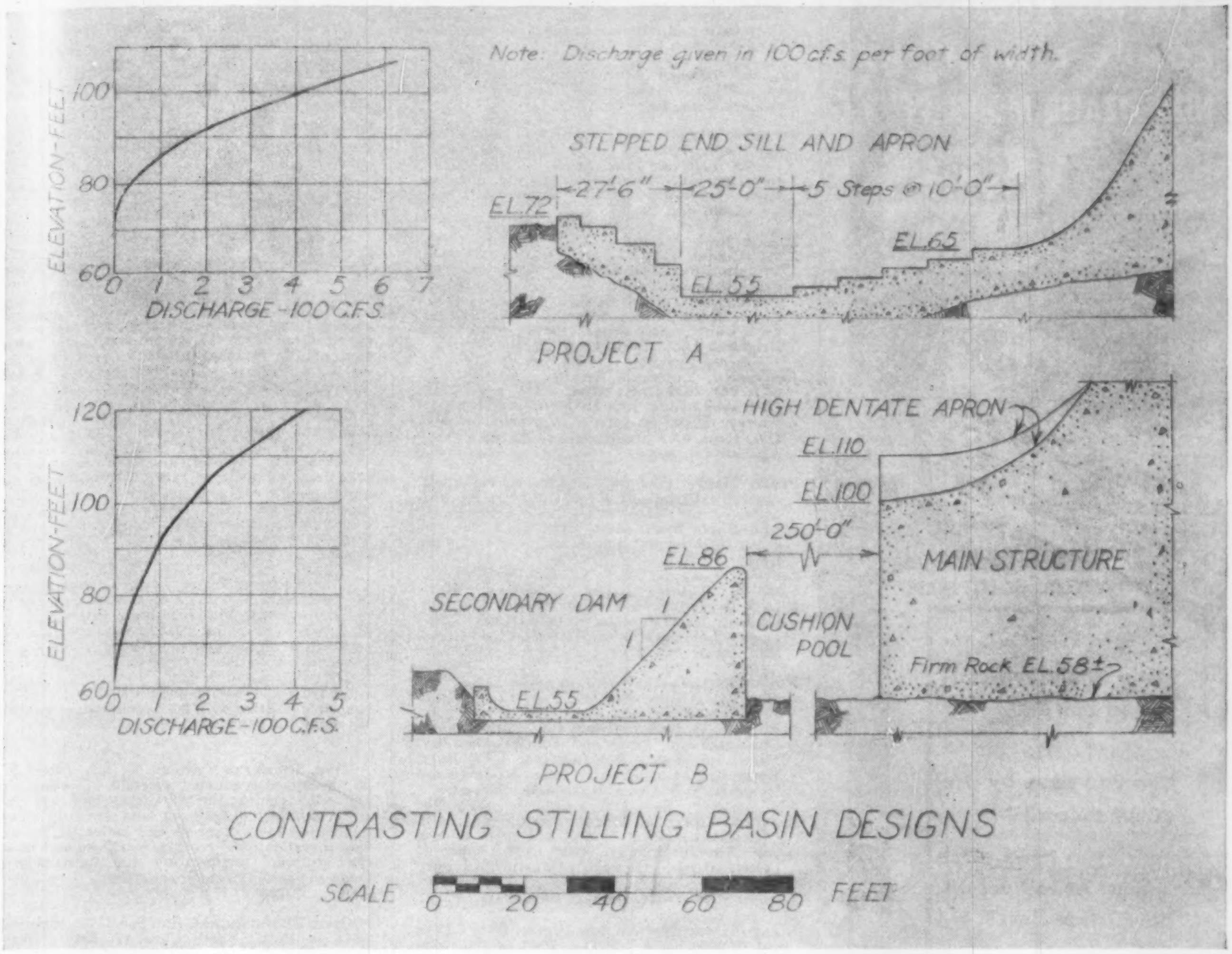
APPLYING FOR JUNIOR

BOURQUARD, EVERETT HOMER, Baltimore, Md. (Age 26) (Claims RCA 1.7) July 1936 to date with U.S. Engrs., as Jun. Eng. Aide, Jun. Engr. (Civ.) and (since June 1940) Asst. Engr. (Civ.).

CARTER, EDWARD JOHN, San Rafael, Calif. (Age 28) (Claims RCA 1.5 RCM 0.3) June 1936 to date with California Div. of Highways as Under Engr. Aide, Jun. Engr. Aide, and (since Aug. 1938) Senior Engr. Aide.

DUSZYNSKI, EDWIN JAMES, Milwaukee, Wis. (Age 27) Aug. 1938 to date with City of Milwaukee, Wis., as Tracer, Water Purification Div., and (since Feb. 1939) Asst. Supervisor of Constr., Dept. of Public Works, WPA Administrative; previously Detailer, Hausman Steel Co., Toledo, Ohio; Chainman, U.S. CCC.

TYPHONITE ELDORADO PENCIL PAGE


Note: Discharge given in 100 c.f.s. per foot of width.
ELEVATION-FEET
100
80
60
0 1 2 3 4 5 6 7
DISCHARGE-100 C.F.S.
STEPPED END SILL AND APRON
EL.72
27'-6"
25'-0"
5 Steps @ 10'-0"
EL.65
EL.55
PROJECT A
ELEVATION-FEET
120
100
80
60
0 1 2 3 4 5
DISCHARGE-100 C.F.S.
HIGH DENTATE APRON
EL.110
EL.100
250'-0"
EL.86
MAIN STRUCTURE
SECONDARY DAM
1
1
CUSHION POOL
Firm Rock EL.58±
EL.55
PROJECT B
CONTRASTING STILLING BASIN DESIGNS
SCALE 0 20 40 60 80 FEET

Two stilling basins developed from hydraulic model tests made at one of America's leading research laboratories for U. S. Army engineers are shown in these Typhonite Eldorado drawings. The degrees used were H, HB, 2H, 3H and 4H. The stilling basins were required because neither of the projects illustrated had sufficient tailwater depths to form true hydraulic jumps at high discharges and so destroy the kinetic energy of water flowing over the dams when spillways were operating.

Both are concrete gravity dams. Project A has a spillway section 180 feet long, with crest about 80 feet above stream bed, with spillway design flood of 120,000 cubic feet per second. Project B's spillway section is 489 feet, with crest about 200 feet above bed; spillway design flood of 217,000 cubic feet per second.

The graphs shown here indicate the natural stage-discharge relations at the two sites. They are directly comparable because they both indicate the rate of flow through a lateral foot of the stilling basin at any given tailwater stage.

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Eljashev, Alexander, Elmhurst, N.Y. (Age 28) 1938 M.S. in C.E. and Arch., State Univ. of Lithuania; Aug. 1940 to date Instructor, Mondell Inst., New York City; previously Draftsman, National Excavation Corporation, and Estimator, Construction Survey Co., New York City; Research Engr., Philips Radio Corporation, Eindhoven and Amsterdam, Holland.

Faller, Vincent Augustus, Baltimore, Md. (Age 27) Aug. 1938 to date Jun. Engr., J. E. Greiner Cons. Eng. Co.

Gossard, Myron Lee, Louisville, Ky. (Age 26) Sept. 1939 to date Instructor, until March 1940 at Iowa State College, Ames, Iowa, and since March 1940 at Univ. of Louisville; previously Detailer, American Bridge Co., Ambridge, Pa.

Haley, John Melville, Corvallis, Ore. (Age 26) (Claims RCA 3.2) Jan. 1940 to date Asst. Irrigation Engr., Oregon State Coll., and Asst. Prof. Cooperative Agent, SCS; previously Draftsman, Turlock (Calif.) Irrigation Dist.; Engr., Arvin-Edison Water Comm., Bakersfield, Calif.; Asst. Engr., East Contra Costa Irrigation Dist., Brentwood, Calif.

Jorgensen, Leonard Nielsen, Austin, Tex. (Age 25) 1937 B.S., Utah State Agri. Coll.; Nov. 1939 to date Jun. Hydr. Engr., Geological Survey, Dept. of Interior; previously with U.S. Dept. of Agriculture, and Cache County Agricultural Assoc.

Prato Nappe, Gregorio, Caracas, Venezuela. (Age 27) (Claims RCA 0.5) 1933 to date with Ministry of Public Works, as Asst. Engr., Chf. Engr., Engr., Asst. Engr. to Bridge Designer for Ministry, and (since 1939) Designing Engr.

Reading, Thomas James, Cambridge, Mass. (Age 25) June 1939 to date with Portland Cement Association on research work; previously Levelman, East Ohio Gas Co., Cleveland, Ohio.

Robertson, Cecil Winston, Elizabeth, N.J. (Age 29) (Claims RC 1.0) Feb. 1939 to Jan. 1940 Job. Engr., and Oct. 1940 to date Civ. Engr., E. B. Badger & Sons Co.; in the interim Chainman, St. Louis and Southwestern Ry. Lines; previously Sub-Inspector, U.S. Engr. Dept., 2nd Area, St. Louis, Mo.; Rodman and Observer, U.S. Coast & Geodetic Survey.

Sperling, Arthur Field, Washington, D.C. (Age 25) (Claims RCA 1.4) Aug. 1940 to date Jun. Structural Engr., War Dept., Office of Quartermaster General, Constr. Advisory Branch, Washington, D.C.; previously Instructor of Plane Table, Univ. of Wisconsin.

Stahl, Edwin Howard, Los Angeles, Calif. (Age 29) (Claims RCA 2.2) Oct. 1935 to Jan. 1939 Draftsman and Jun. Engr., and June 1940 to date Asst. Engr., U.S. Engr. Office, in the Interin Jun. Engr., successively with Vicksburg (Miss.) Engr. Dist. and Los Angeles (Calif.) Engr. Dist.

Steele, Joseph Middleton, 2d, Philadelphia, Pa. (Age 23) 1939 C.E., Cornell Univ.; Aug. 1940 to date Draftsman, United Engrs. and Constrs., Inc.; previously with Inland Steel Co., Chicago, Ill.

Taxer, Milton, Portland, Ore. (Age 25) 1938 B.S. in Civ. Eng., Iowa State Coll.; May 1939 to date Jun. Engr., U.S. Engr. Office, Portland, Ore.; previously with U.S. Bureau of Public Roads, Ames, Iowa.

1940 GRADUATES

	Age
ALA. POL. INST. (B.S. in Civ. Eng.)	
Smith, Thomas Sherburne, Jr.	(21)
CORNELL UNIV. (C.E.)	
Benedict, Farrand Northrop, Jr.	(23)
MASS. INST. TECH. (S.M.)	
Babcock, Willard Farrington (Also 1939 S.B.)	(23)
UNIV. OF TEX. (B.S. in C.E.)	
Fuller, Alfred Smith	(22)
UNIV. OF WASH. (B.S. in Civ. Eng.)	
Gorton, Marquand Sarchet	(23)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

Items are furnished by the Engineering Societies Personnel Service, 31 West 39th Street, New York, N.Y. Address replies to key number, care of New York office, unless Chicago, Detroit, or San Francisco office is designated. See page 132 of Society's 1940 Year Book for details of procedure.

CONSTRUCTION

Construction or Locating Engineer; Assoc. M. Am. Soc. C.E.; 42; single; 20 years experience in responsible charge of highway and railroad location and construction, including bridges and various types of concrete and asphalt pavements; construction of streets, sewers, earth dams, industrial plants, drainage projects; surveys, plans, estimates, reports. Location preferred, Pacific Coast. C-787-302-A-3-San Francisco.

Construction Superintendent, Hydraulic Engineer; Assoc. M. Am. Soc. C.E.; conversant with nearly all types of construction; years of experience in responsible charge of prominent organizations on large varied projects, domestic and foreign; can organize and handle work of magnitude; munition, chemical, industrial, and hydro plants, transmission lines, dams, tunnels, docks, and bridges. Past employers accessible. C-788.

Construction Engineer-Executive; Assoc. M. Am. Soc. C.E.; married; extensive experience in building construction in several states, covering all phases—planning, contracting, purchasing, supervision, actual job superintendence; over 15 years in responsible charge of large operations. Registered in mid-Western and Eastern states. Employed by federal government; desires responsible position with advancement possibilities. Integrity and personal qualifications, highest rank. C-789.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 39; technical graduate; married; 14 years field and office engineering experience on heavy construction, including earth and concrete dams, navigation locks, tunnels and highways, foundation investigations, reports, estimates and valuation studies; organization and supervising of field engineering for large or small jobs a specialty. C-790.

Civil Engineer; M. Am. Soc. C.E.; registered in New York, North Carolina; 38; married; graduate civil engineer with legal education; 18 years experience field and office; general engineering, including hydroelectric plants, earthen, masonry dams, water works, sewers, paving, planning; location, design, estimating, supervision, construction, appraisals, expert witness, investigations, reports. Now employed, federal government; desires responsible position with opportunity for advancement. C-794.

DESIGN

Civil Engineer; Assoc. M. Am. Soc. C.E.; registered; 28 years experience on design, location, construction, and operation of oil and gasoline pipe lines, oil storage; 9 years in Central America and Mexico on design and construction of wharves, bridges, roads, buildings, drainage, and irrigation. Speaks, reads, and writes Spanish. Will go anywhere; available immediately. C-786.

EXECUTIVE

Construction Engineer; M. Am. Soc. C.E.; 53; C.E. degree; New York license; 30 years design, construction supervision, general contracting, consulting service for contractors; expert on cost analysis, bids, contracts, plant layout, purchasing, organization, supervision, and general management of engineering construction; excavations, foundations, bridges, buildings, railroads, highways, airports, river and harbor construction. C-792.

HYDRAULIC

Associate Civil Engineer; Assoc. M. Am. Soc. C.E.; 35; B.C.E. degree; married; 1½ years U.S. Department of Agriculture flood control surveys, in charge of upstream engineering; preliminary design and cost estimating of dams, walls, channels; erosion and economic studies, reports; 8 years U.S. Geological Survey; 2 years U.S. Forest Service topographic mapping; aerial photo map compilation, in charge of mapping projects, training junior engineers; U.S. Civil Service rating as associate cadastral engineer. Employed. Location preferred California, but will go anywhere. C-791-4010-A-1-San Francisco.

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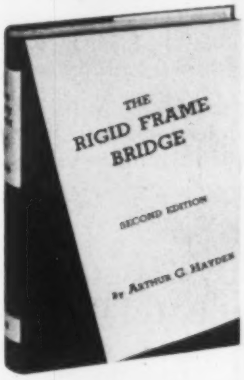

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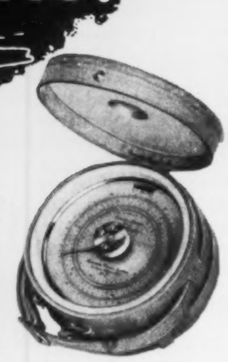

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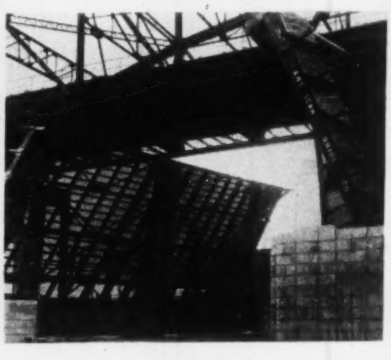

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RECENT BOOKS

New books if interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

BUILDING ESTIMATOR'S REFERENCE BOOK, 9 ed. 1701 pp., $6^1/_2 \times 4$ in., $10. "Vest Pocket Estimator" (220 pp., $5^1/_2 \times 2^1/_2$ in.) free with *Building Estimator's Reference Book.* By F. R. Walker. Frank R. Walker Co., Chicago, 1940. Illus., diagrs., charts, tables.

A comprehensive treatment of all the various items that may be required for the accurate estimation of a contracting job. Beginning with the general question of preparing a properly safeguarded estimate, the book discusses overhead expenses, and then continues with detailed information as to materials, costs, equipment, and labor for everything from excavation to small hardware. A special feature is the illustrative set-ups of cost calculations, into which can be inserted local prices and costs. Condensed estimating information is found in the "Vest-Pocket Estimator," which accompanies the main volume.

DESIGN OF CONCRETE STRUCTURES, 4 ed. By L. C. Urquhart and C. E. O'Rourke. McGraw-Hill Book Co., New York and London, 1940. 564 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $4.50.

The aim of the authors is to provide a text on concrete and reinforced concrete for both elementary and more advanced courses in engineering schools. The theory of concrete design is sufficiently developed to give the beginner a thorough understanding of the fundamentals. Complete designs of the commoner structures are given, to bring together all the fundamental theory involved. The new edition has been revised in accordance with current practice, and all tables and diagrams have been collected in an appendix for easier reference.

ENGINEERING MECHANICS, 2 ed. By S. Timoshenko and D. H. Young. McGraw-Hill Book Co., New York and London, 1940. 523 pp., diagrs., charts, tables, 9 × 6 in., cloth, $4.

In this new one-volume edition, the statics section contains general considerations of plane forces and space forces with a chapter on the principle of virtual displacements. Rectilinear and curvilinear translations and the motions of a rigid body are discussed in the dynamics section, which includes a short chapter on relative motion.

MANUAL OF INDUSTRIAL HEALTH HAZARDS. By J. B. Ficklen. Service to Industry (Box 133), West Hartford, Conn., 1940. 176 pp., illus., diagrs., charts, tables, $9^1/_2 \times 6$ in., cloth, $4.

This manual presents methods for evaluating the health hazards from exposures to various dusts, vapors, and gases that occur in industry. The book opens with directions for air sampling. Following this, the occurrence, uses, properties, clinical symptomology, physiological response, and method of estimation are given for over ninety noxious dusts and gases. An accompanying table shows the potential health hazards in various industries.

PUBLIC WATER SUPPLIES, 4 ed. rev. By F. E. Turneaure, H. L. Russell, and M. S. Nichols. John Wiley & Sons, New York, 1940. 704 pp., illus., diagrs., charts, maps, tables, $9^1/_2 \times 6$ in., cloth, $6.

The whole field of public water supply is covered in this comprehensive standard textbook. Part I, on requirements and resources, deals with the determination of the quantity of water required, sources of supply, the relation of drinking water to health, and the examination of water supplies. Part II, on the construction of water works, covers hydraulics, wells, dams and reservoirs, sedimentation and coagulation, filtration and other purifying processes, pumping machinery, pipe lines, distribution, operation, and maintenance. Literature references accompany most of the chapters.

PUMPS. By F. A. Kristal and F. A. Annett. McGraw-Hill Book Co., New York and London, 1940. 339 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.50.

A practical treatment of pumping problems for the designer, manufacturer, sales representative, operator, and student. Types and designs of pumps are described, and such important applications as boiler feed, deep wells, sumps, and sewage are given extended treatment. Pump installation, operation, and supervision are also treated, including troubles and remedies.

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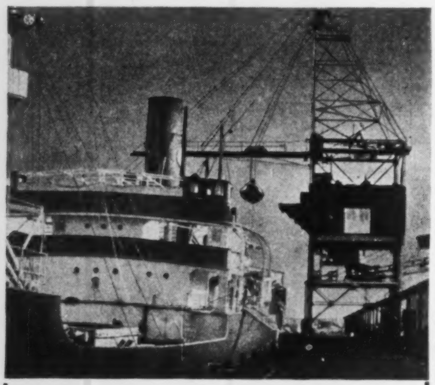

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ROADS AND STREETS

FLORIDA. New 69-Mile Everglades Highway. *Eng. News-Rec.*, vol. 125, no. 9, Aug. 29, 1940, pp. 270–272. Equipment and methods used in construction of 69-mile highway through swamps of Florida Everglades, from South Bay on Lake Okeechobee to Miami and Fort Lauderdale; road embankment consists of rockfill in muck trench excavated to rock; features of dragline excavators and drillboats.

HIGHWAY ADMINISTRATION, PERSONNEL. Oregon's Merit System for...Highway Personnel Administration, C. B. McCullough. *Western Construction News*, vol. 15, no. 7, July 1940, pp. 236–239. Review of method and procedure developed and used by Oregon State Highway Department for selection and advancement of engineering employees; rating forms; personnel specifications; final selection of personnel; training of personnel; Oregon State Highway Department salaries.

HIGHWAY ENGINEERING, RESEARCH. Quebec's Modern Highway Laboratory, J. B. Garneau and C. E. Beland. *Roads & Bridges*, vol. 78, no. 8, Aug. 1940, pp. 15–17 and 69. Organization and equipment of highway laboratory of Quebec Roads Department for testing of soils and highway materials; research activities; field testing.

HIGHWAY SYSTEMS, ONTARIO. Express Road Systems, R. M. Smith. *Roads & Bridges*, vol. 78, no. 8, Aug. 1940, pp. 19–21, 60, and 62–63. Function of expressways in modern highway development, with special reference to highway system of Canada; control of divided highways; skid-proof surfaces.

HIGHWAY SYSTEMS, PENNSYLVANIA. Pennsylvania Turnpike, B. Nordberg. *Rock Products*, vol. 43, no. 9, Sept. 1940, pp. 33–51. Series of articles showing how aggregate and cement plants met tough specifications for big road construction job by modernizing methods and equipment: Turnpike Sets New Standards; Specifications for Aggregates and Cement; Fitting Plants for Increased Production.

HIGHWAY SYSTEMS, UNITED STATES. Highways for America's Defense, J. Randolph. *Crushed Stone J.*, vol. 15, no. 3, June-July 1940, pp. 25–26. Hand in hand with armed preparedness, roads must be considered and built from military viewpoint. Before U. S. House of Representatives.

IOWA. Iowa Road Carved Through Loess Bluffs. *Eng. News-Rec.*, vol. 125, no. 9, Aug. 29, 1940, pp. 277–279. Equipment and methods used in construction of 3-mile stretch of new road, near Magnolia, Iowa, through loess bluffs; to prevent side erosion in cuts, up to 80 ft deep, vertical slopes and smooth benches on steps were formed with standard grading equipment, with no hand trimming required; special drains placed over steps take care of surface water that cannot be by passed away from faces of cut; drainage structures.

MAINTENANCE AND REPAIR. Cost Analysis Charts for Street Maintenance Work, V. A. Hill. *Western Construction News*, vol. 15, no. 7, July 1940, pp. 249–250. Experience of city of Oakland, Calif., with use of "heater planer" for repairing of surface corrugations, weeping, blisters, bleeding, and the like, which occur on asphalt surfaced streets; operation of planer; costs of planing.

STABILIZATION. Stabilized Construction on Natchez Trace. *Roads & Streets*, vol. 83, no. 8, Aug. 1940, pp. 27–28. Materials, equipment, and methods used in construction of 12-mile section of parkways from Nashville, Tenn., to Natchez, Miss., stabilized with calcium chloride.

VIADUCTS. Sidehill Highway. *Western Construction News*, vol. 15, no. 8, Aug. 1940, pp. 265–267. Design and construction of concrete-and-steel deck sidehill viaduct, 925 ft long, carried on steel piles through narrow canyon of unstable formation near north end of Los Gatos-Santa Cruz highway, California; design features extreme rigidity with ample provision for individual movement of 37 simple spans; driving piles; forming and concreting.

SANITARY ENGINEERING

CANADA. Modern Sanitation and Water Supply Practice, W. Storrie and A. E. Berry. *Eng. J.*, vol. 23, no. 9, Sept. 1940, pp. 380–391. Review of Canadian engineering practice relating to water works, sewerage systems, stream pollution, refuse disposal, swimming pools, milk control; development of water works systems; water works legislation; quality of raw water supplies; developments in water filtration and chlorination; water works intakes; control of typhoid fever; legislation on sewerage systems; operation of activated sludge plants. Before Brit.-Am. Eng. Congress.

SEWERAGE AND SEWAGE DISPOSAL

BACTERIOLOGY. Typhoid Bacteria in Sewage and in Sludge, C. P. Mom and C. O. Schaeffer. *Sewage Works J.*, vol. 12, no. 4, July 1940, pp. 715–737. Investigation into hygienic significance of sewage purification in tropics with regard to typhoid fever; typhoid bacteria in surface water; typhoid bacteria in sewage; purifying capacity of Imhoff tank; typhoid bacteria in sludge; behavior of typhoid bacteria during digestion of sludge. Bibliography.

DISPOSAL PLANTS, EQUIPMENT. Gadget Contest, Central States Sewage Works Association Meeting in October 1939. *Sewage Works J.*, vol. 12, no. 4, July 1940, pp. 803–807. Symposium on following: Determination of Hydrogen Sulfide in Sewage and Polluted Water, G. Martin; B. O. D. Dilution Dispenser, D. Backmeyer and W. E. Ross; Pump Cleaning Gadget, P. W. Richards.

DISPOSAL PLANTS, GRAND RAPIDS, MICH. Seven Years' Operation Data, Grand Rapids Sewage Works. *Am. City*, vol. 55, no. 9, Sept. 1940, pp. 66–67. Summary of operating results for 1932–1939 of Grand Rapids, Mich., sewage treatment plant, serving population of about 180,000.

DISPOSAL PLANTS, LANSING, MICH. Year's Experience in Digestion of Sewage and Garbage Solids, G. F. Wyllie. *Sewage Works J.*, vol. 12, no. 4, July 1940, pp. 760–770. Description of sewage and garbage treatment plants of Lansing, Mich.; system of garbage collection; garbage grinders; problem of bones and eggshells in garbage; clogging of digested sludge pumps; gas production; garbage ordinance.

PLANTS, ROCK ISLAND, ILL. Refuse and Sewage Plant Combined for Profit, G. O. Consoer and D. W. Townsend. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, pp. 221–224. Design and construction of modernized sewerage system nearing completion at Rock Island, Ill., including new storm-water and intercepting sewers, and pumping equipment and dual sewage and garbage treatment plant, with incinerators for both municipal refuse and sewage sludge; estimated cost $2,900,000; sewage gas for pumping; garbage grinding building and mixing tank details.

PLANTS, STAUNTON, VA. Sanitary Sewerage System for Staunton, Virginia, R. C. Regnier, Jr. *Sewage Works Eng. & Mun. Sanitation*, vol. 11, no. 9, Sept. 1940, pp. 431–434 and 446. Design and construction of new two-mgd sewage disposal plants of Staunton, Va., including vitrified clay pipe intercepting sewer; interceptor connections; pre- and post-chlorination; stage sludge digestion; drying beds; preliminary design of future trickling filters based on loading of 300,000 gal per day per acre foot and stone depth of 8 ft.

SEWAGE DISPOSAL, LOS ANGELES, CALIF. Sewage Treatment Experiments Conducted at Los Angeles City Pilot Plant, H. G. Smith and E. G. Studley. *Sewage Works J.*, vol. 12, no. 4, July 1940, pp. 745–759. Report on studies made at special experimental pilot plant for design of improvements for Los Angeles sewerage system, with special reference to processes of digestion, clarification, filtration, and elutriation.

INDEX OF PRODUCTS

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Lighting Plants
Fairbanks, Morse & Co.

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SEWERS, DESIGN. Structural Design of Sewers, C. W. Steedman. *Instn. Mun. & County Engrs.—J.*, vol. 66, no. 25, May 21, 1940, pp. 701–739. Analysis of stresses produced in sewers due to earth loading and superimposed loads; design of sewers; haunched pipe sewers; encased pipes; reinforced concrete culverts; brick sewers; moment of resistance of stoneware sections.

SEWERS, GREAT BRITAIN. Grant Thorold Sewerage Scheme, H. Snape. *Civ. Eng.* (London), vol. 35, no. 408, June 1940, pp. 164–167. Design and construction of reinforced concrete culverts and main intercepting sewer for Grimsby, England, costing about £200,000; cost data.

SLUDGE. Sludge as Fertilizer, L. W. Van Kleeck. *Am. City*, vol. 55, no. 9, Sept. 1940, pp. 73 and 75. Review of objections to use of raw sewage sludge; types of digested sludge; methods of applying digested sludge.

SLUDGE. Treatment of Supernatant Sludge Liquor by Coagulation and Sedimentation, C. E. Keefer and H. Kratz, Jr. *Sewage Works J.*, vol. 12, no. 4, July 1940, pp. 738–744. Report on recent experiments at Baltimore sewage works to determine effect of following factors on clarification of sludge liquor: mixing coagulant and sludge liquor, flocculating sludge liquor; pH adjustment; quantity of coagulant used.

STRUCTURAL ENGINEERING

BEAMS, CONCRETE. Construction Design Chart—LV—Additional Compression Steel in Beams, J. R. Griffith. *Western Construction News*, vol. 15, no. 7, July 1940, p. 255. Alignment chart for figuring area of additional steel required in concrete beams reinforced for compression; numerical examples.

BEAMS, STEEL. Non-Axial Loads on Structural Steelwork Beams, R. F. Davis. *Engineering*, vol. 150, no. 3890, Aug, 2, 1940, pp. 81–84. Calculation of beams such as occur in boiler supporting structures and furnace work, where, in order not to expose steelwork to high temperatures, refractory and insulating materials are necessarily non-axially supported; method presented is extension of that proposed by Timoshenko for particular case of central torque on simple I-beam, to other types of loading and structural members.

CHIMNEYS, DESIGN. These Principles Are Important in Chimney Construction. *Brick & Clay Rec.*, vol. 97, no. 2, Aug. 1940, pp. 29–30. Summary of important points for designing and constructing chimneys.

COLUMNS, DESIGN. Dimensionless Coefficients Applied to Solution of Column Problems, K. G. Merriam. *J. Aeronautical Sciences*, vol. 7, no. 11, Sept. 1940, pp. 478–480. Analysis indicates that enormous simplification in handling of column problems can be effected through use of dimensionless coefficients described.

EARTHQUAKE RESISTANCE. Earthquake Reconstruction in India. *Ry. Gaz.*, vol. 73, no. 5, Aug. 2, 1940, pp. 2122–2124. Measures taken by North Western Railway to insure that all railway buildings throughout danger zone in Baluchistan are earthquake-resisting.

FRAMED STRUCTURES, DESIGN. Analysis of Continuous Frames, T. H. Stephenson. *Instn. Engrs. Australia—J.*, vol. 12, no. 6, June 1940, pp. 163–175. Theoretical mathematical discussion of analysis of stresses in continuous beams and frames, including extension of standard method of "characteristic points"; initial point on moment closing line; conjugate points in adjacent spans; settlement of supports and displacement of joints; frames involving closed circuit; example of continuous frame bridge design.

WOODEN CONSTRUCTION. Design Tables, R. H. L. Sung. *Civ. Eng.* (London), vol. 35, no. 408, June 1940, pp. 169–173. Formulas and tabulated data for design of beams and columns of softwood and hardwood, with special reference to timbers available in Island of Borneo; illustrative examples.

WALLS, PERMEABILITY. Tests of Resistance to Rain Penetration of Walls Built of Masonry and Concrete, R. E. Copeland. *Bldg. Standards Monthly*, vol. 9, no. 8, Aug. 1940, pp. 10–14. Report on Portland Cement Association experimental study, including over 200 permeability tests, for developing information on resistance of different wall constructions to wind-driven rain, and on various factors which influence permeability of masonry; performance rating of walls; effect of workmanship and of mortar composition on performance of 8-in. brick walls.

TRAFFIC CONTROL

HIGHWAY TRAFFIC SIGNS, SIGNALS, AND MARKINGS. Zone Marking Standards as Adopted for Ontario Highways. *Roads & Bridges*, vol. 78, no. 8, Aug. 1940, pp. 14, 66, and 69. Description of double-line system of pavement marking, or zone painting adopted for roads in King's Highway system of Ontario Department of Highways; Ontario standards.

ROADS AND STREETS, DESIGN. Red Concrete for Slow Traffic, W. N. Rees. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, pp. 212–213. Construction of third slow traffic lane surface with red iron oxide concrete for slow heavy trucks on hill of main road, about 15 miles north of Nashville, Tenn.

TUNNELS

ANTI-AIRCRAFT PROTECTION, SUBWAYS. Tube Railway Protection. *Elec. Rev.*, vol. 126, no. 3252, Mar. 22, 1940, pp. 333–335. Description of electrically operated floodgates safeguarding London underground railways; problem was to protect railways from flooding; horizontal sliding gates are steel units; weighing 6 tons, which slide across running tunnel; drop sector gates, weighing $4^1/_2$ tons, employed to close passageways leading to platforms; hinged flap gates, which weigh $10^1/_2$ tons, used to seal double-track tunnel on surface lines.

CONSTRUCTION, WASHINGTON. Twin Tunnels Driven Through Clay for Lake Washington Bridge Project. *Western Construction News*, vol. 15, no. 7, July 1940, pp. 246–249. Tunnel driving through blue clay on twin-vehicular bores, which will provide connections between Lake Washington pontoon bridge and City of Seattle; design features; advance drifts; lining procedure; contractor's plant.

MINES AND MINING. Carlton Drainage Tunnel, G. T. Kearns, Jr. *Explosives Engr.*, vol. 18, no. 6, June 1940, pp. 171–172, 181–182, and (illustrations) pp. 173–180. Progress notes on driving of tunnel described in other papers previously indexed from various sources; comparative summary of averages of tunnel-driving data from August 1939 to April 1940, inclusive; drilling and blasting; ventilation, compressed air, and drainage.

NEW YORK. Record Progress by Walsh Construction Company, A. Simpson. *Explosives Engr.*, vol. 18, no. 5, May 1940, pp. 138–142. Notes on driving and lining of rock tunnel to finish at $13^1/_2$-ft diameter, on Walsh Construction Company contract 316 on Delaware Aqueduct, near Gardner and Plattekill, N. Y.; typical drill round; loading and blasting; equipment; muck handling.

RAILROAD, CALIFORNIA. Twelve Tunnels Driven in Rock to Relocate Railroad Around Shasta Dam, J. P. Densmore and R. A. Midthun. *Construction Methods*, vol. 22, no. 8, Aug. 1940, pp. 50–53, 100, 102–104, and 106. Design and construction of 21 tunnels, having total length of over $3^1/_2$ miles, in relocating 37 miles of Southern Pacific Railroad around site of reservoir, which will be created by Shasta Dam above Redding, Calif.; description of full face drilling jumbo, having three operating decks and carrying eight drifter drills; establishing top heading; drilling practice; compressor plant; drill steel.

SUBWAY CONSTRUCTION, CHICAGO. Chicago Builds Subway, C. H. Vivian. *Compressed Air Mag.*, vol. 45, no. 8, Aug. 1940, pp. 6204–6212. Initial system will consist of 7.7 route-miles of double-tube subway; divided into two lines; there are two types of tunnel, one of horseshoe section and other of circular section; former is advanced by conventional earth tunneling, while latter requires use of shields for subaqueous boring; illustrated description of methods and equipment used in excavation, tunnel driving, and concrete lining, etc; estimated cost of project is $46,000,000.

SUBWAY CONSTRUCTION, CHICAGO, ILL. Hand Mining on Chicago Subways. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 159–164. Report on hand mining methods used in tunneling of 4.6 miles of new Chicago subway, improved by eliminating usual needle beam through adoption of better steel rib and plate ground support and consistent use of compressed air up to 12-lb pressure; multiple bench tunneling; coordinated daily placement of concrete lining.

TUNNELS, PUMPS. Pumping and Related Equipment Used on Mono Craters Tunnel Project, S. M. Dunn. *Am. Water Works Assn.—J.*, vol. 32, no. 8, Aug. 1940, pp. 1242–1258. Description of various types of pumps and their performance in lowering ground-water level for construction of 12-mile long Mono-Crater tunnel of water supply of Los Angeles, Calif.; removal of muck; maintenance and operation.

VEHICULAR, NEW YORK CITY. Queens Midtown Tunnel, New York. *Engineer*, vol. 169, nos. 4403, 4404, and 4405, May 31, 1940, pp. 491–493; June 7, pp. 512 and 516; and June 14, pp. 530–532. Illustrated description of first vehicular tunnel to underrun East River; each of twin tubes will provide 21-ft roadway for two lanes of traffic; full length of crossing is 7,865 ft for west-bound tube, and 7,400 ft for east-bound tube; cast-iron lined sections are 31 ft in outside diameter; throughout rock tunnel sections, where diameter is 32 ft, 10 in., structural steel linings have been adopted.

WATER SUPPLY, BALTIMORE, MD. Baltimore's New Water Tunnel, L. Small. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 346–350. Design and construction of 7-mile pressure tunnel, 12 ft in diameter, now nearing completion at Baltimore, Md., featuring eductor system to be used for unwatering of conduit; selecting route; checking ground; concrete and steel lining; cut-and-cover section; controlling flow.

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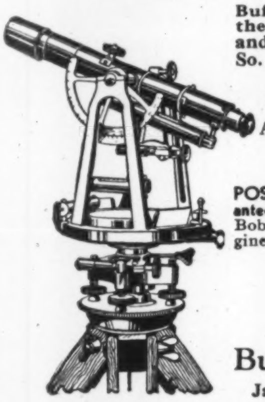

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4. Calcium chloride accomplishes uniform curing—makes the mix more workable, producing denser, more waterproof concrete.

5. Does all this *without changing the normal chemical action of the portland cement.*

6. Results of tests by the National Bureau of Standards, Portland Cement Association, American Road Builders Association, and Highway Research Board are contained in our 48 page book "Calcium Chloride and Portland Cement." WRITE TODAY FOR THIS FREE BOOK! Solvay Sales Corporation, Dept. 80–1240, 40 Rector St., New York, N. Y.

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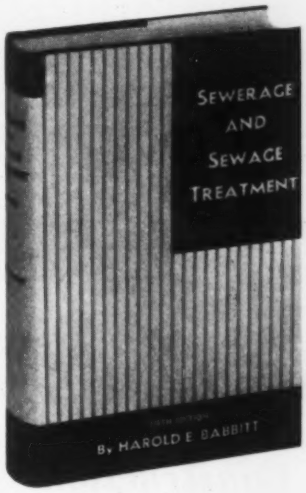

SEWERAGE AND SEWAGE TREATMENT

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HAROLD E. BABBITT
Professor of Sanitary Engineering
University of Illinois

In eighteen years there have been five editions of this complete treatise on methods and practice of sewage treatment and disposal. This means, of course, that when new and important changes occur, "Babbitt" is revised to include them. The 1940 edition of this book reflects particularly the trend toward mechanization and the revival of chemical methods of sewage treatment which have been signally influential in affecting methods of treatment and operation.

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Fifth Revised Edition (Sept. 1940)
648 pages 237 illus. 6 by 9 $5.00

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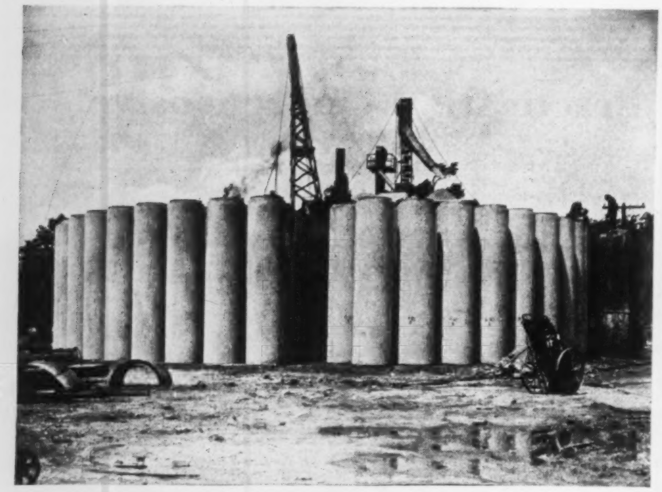

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- In Defense Construction speed is essential—but quality must not be sacrificed.

- The production of Lock Joint Reinforced Concrete Pressure Pipe Lines in local manufacturing plants is a skilled operation, developed to a high degree of perfection.

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PRESSURE PIPE

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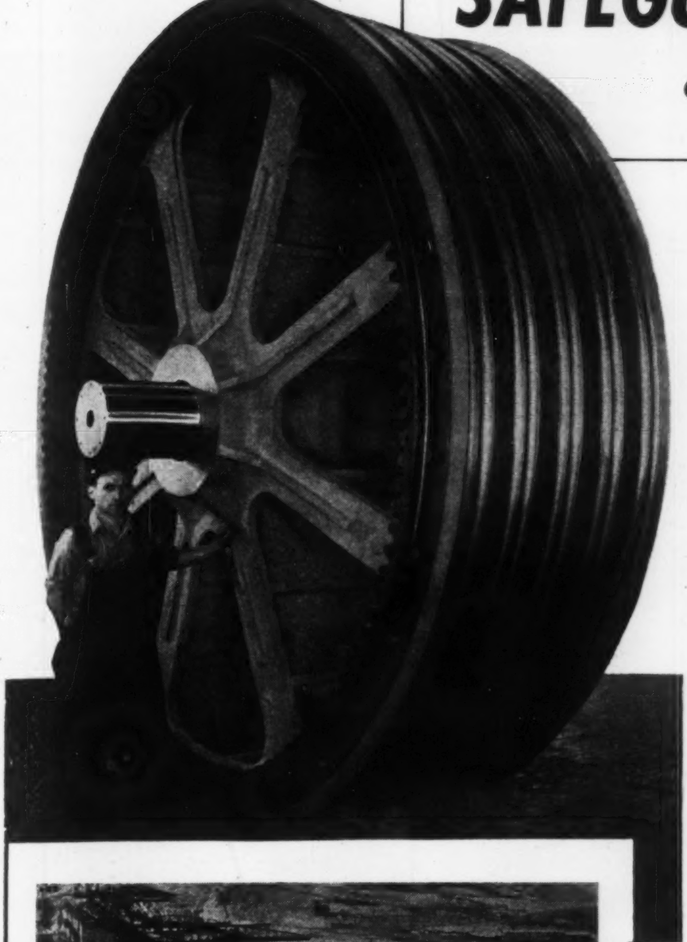
How engineers

SAFEGUARD CASTINGS

on hard jobs . . .



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NICKEL

CAST STEEL + 2.60% NICKEL

One of four 12′2″ sheaves for the Snake River lift bridge between Lewiston, Idaho, and Clarkston, Wash., cast in the Columbia Steel Co. foundry at Pittsburg, Calif., from a 2.60% Nickel steel showing tensile strength of over 90,000 p.s.i. Nickel added to steels increases toughness, wear resistance and minimizes fatigue strains.

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET
NEW YORK, N. Y.

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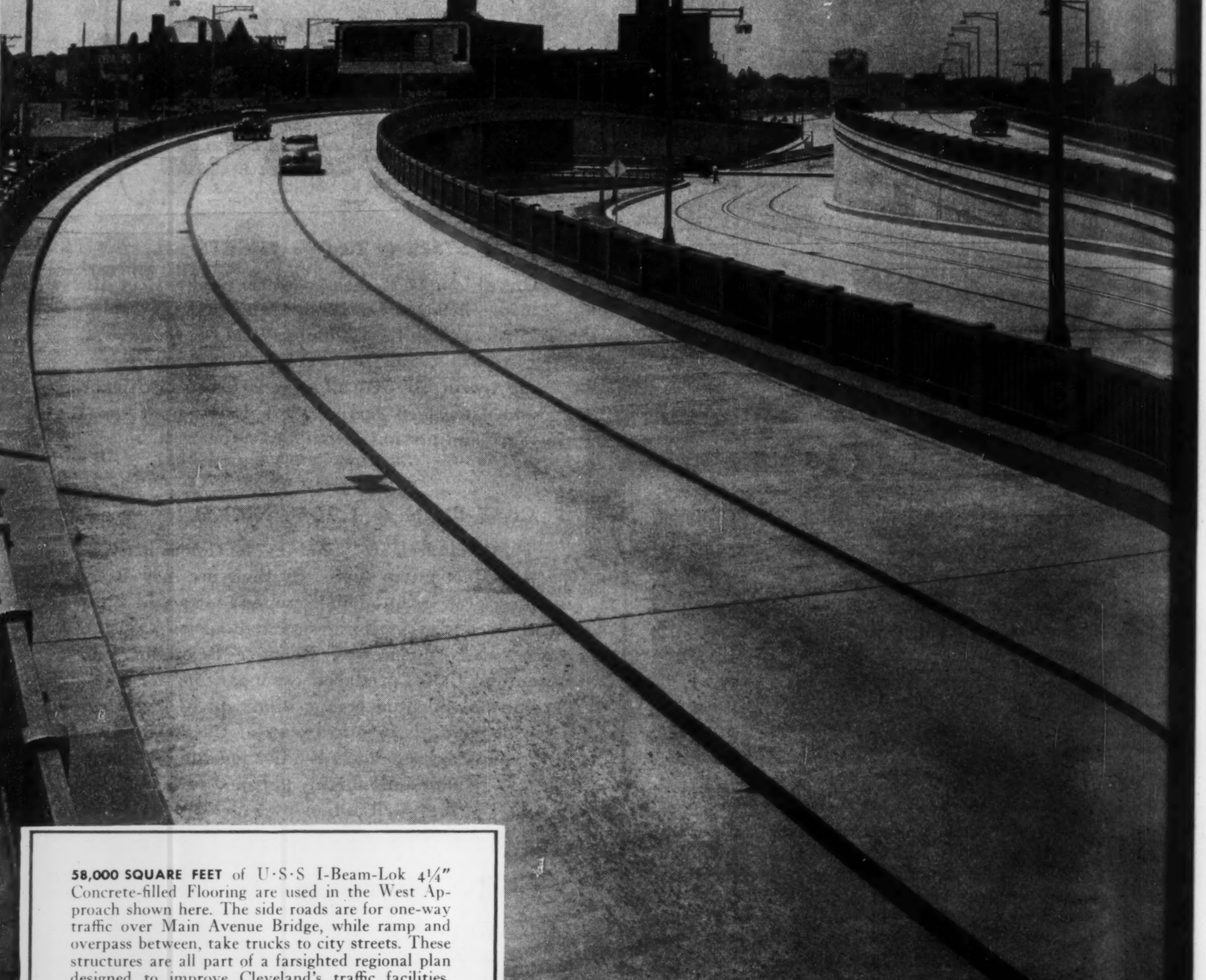
40 miles an hour through



58,000 SQUARE FEET of U·S·S I-Beam-Lok 4¼" Concrete-filled Flooring are used in the West Approach shown here. The side roads are for one-way traffic over Main Avenue Bridge, while ramp and overpass between, take trucks to city streets. These structures are all part of a farsighted regional plan designed to improve Cleveland's traffic facilities. The entire Main Avenue Bridge project, including these approaches, was designed and constructed under the supervision of Cuyahoga County Engineer, John O. McWilliams, and W. E. Blaser as Bridge Engineer; Fred L. Plummer, Chief Designing Engineer and Ralph W. Dietrick as Construction Engineer. (General contractor for the superstructure: The Sam W. Emerson Co. Sub-contractors on the superstructure, for the East and West Approaches, Mt. Vernon Bridge Company, Mt. Vernon, Ohio; for Lakefront Ramp, R. C. Mahon Co., **Detroit.)**

UNITED S

downtown Cleveland!

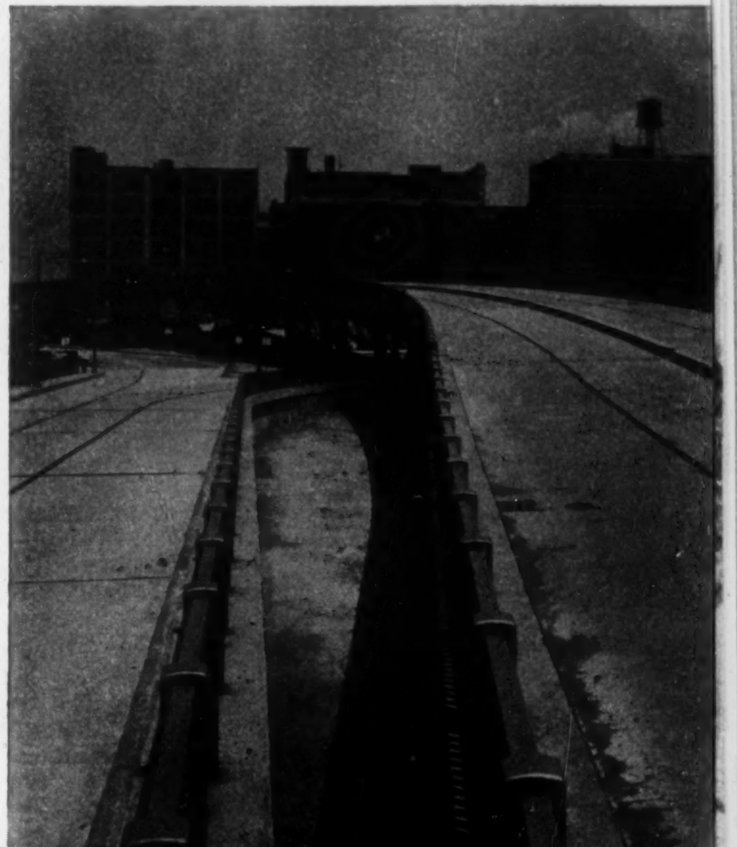
190,000 sq. ft. of I-Beam-Lok Flooring on Lakefront Freeway now safely speed east-west traffic past congested area.

WITH the opening of the new Main Avenue Bridge and 6 miles of lakefront boulevard, known as the Lakefront Freeway, busy Cleveland provides the motorist with a fast through-city route that is free of cross traffic and bottlenecks.

4¼" U·S·S I-Beam-Lok Concrete-filled Flooring has been applied in the Lakefront Ramp, and on both easterly and westerly approaches, where its safe, anti-skid road surface permits traffic to maintain a fast pace on the curves and grades. In spite of its light weight of only 55 lbs. per sq. ft., this smooth-riding floor has ample strength to carry the H-20 loading called for by the design. Its ability to resist the shock and grind of heavy traffic assures long service and low maintenance. U·S·S I-Beam-Lok also has other advantages—it is fire safe, free from progressive cracking, easy to lay and reasonable in cost.

U·S·S I-Beam-Lok Concrete-filled Flooring is available also in 2½", 3", and 3½" sizes, weighing respectively 40.2, 47, and 53.5 lbs. per sq. ft. I-Beam-Lok Open Flooring weighs only 18.6 lbs. per sq. ft.! Thus I-Beam-Lok, when incorporated into the original bridge design, makes possible substantial reduction in deadload which can often be translated into worthwhile savings in the supporting structure—with no reduction of safety or service life.

To date more than 3 million feet of U·S·S I-Beam-Lok have been applied. On the Thousand Island Bridge across the St. Lawrence—on the International Highway Bridge at Port Huron—on the Queensboro, Manhattan and Williamsburg spans in New York—on the Outer Drive bascule bridges in Chicago. North, east, south and west, hundreds of new bridges and old have been floored with U·S·S I-Beam-Lok because of its obvious fitness to meet modern traffic needs. Our engineers will be glad to discuss its economic possibilities with you.



54,500 SQUARE FEET of 4¼" Concrete-filled U·S·S I-Beam-Lok are used to floor the overpass sections of the Lakefront Ramp. A total of 73,300 square feet of this flooring was applied to the entire East Approach. On the Lakefront Ramp, at right, a raised central strip separates the two 12-ft. traffic lanes, and an escape walk in each direction is provided. The through lane roadway of the ramp at left is 34 ft. wide. All structures are designed for H-20 loading. (General contractors for superstructure: The Sam W. Emerson Company and The National Engineering & Contracting Company.)

U·S·S I-BEAM-LOK

"New life for old bridges... longer life for new"

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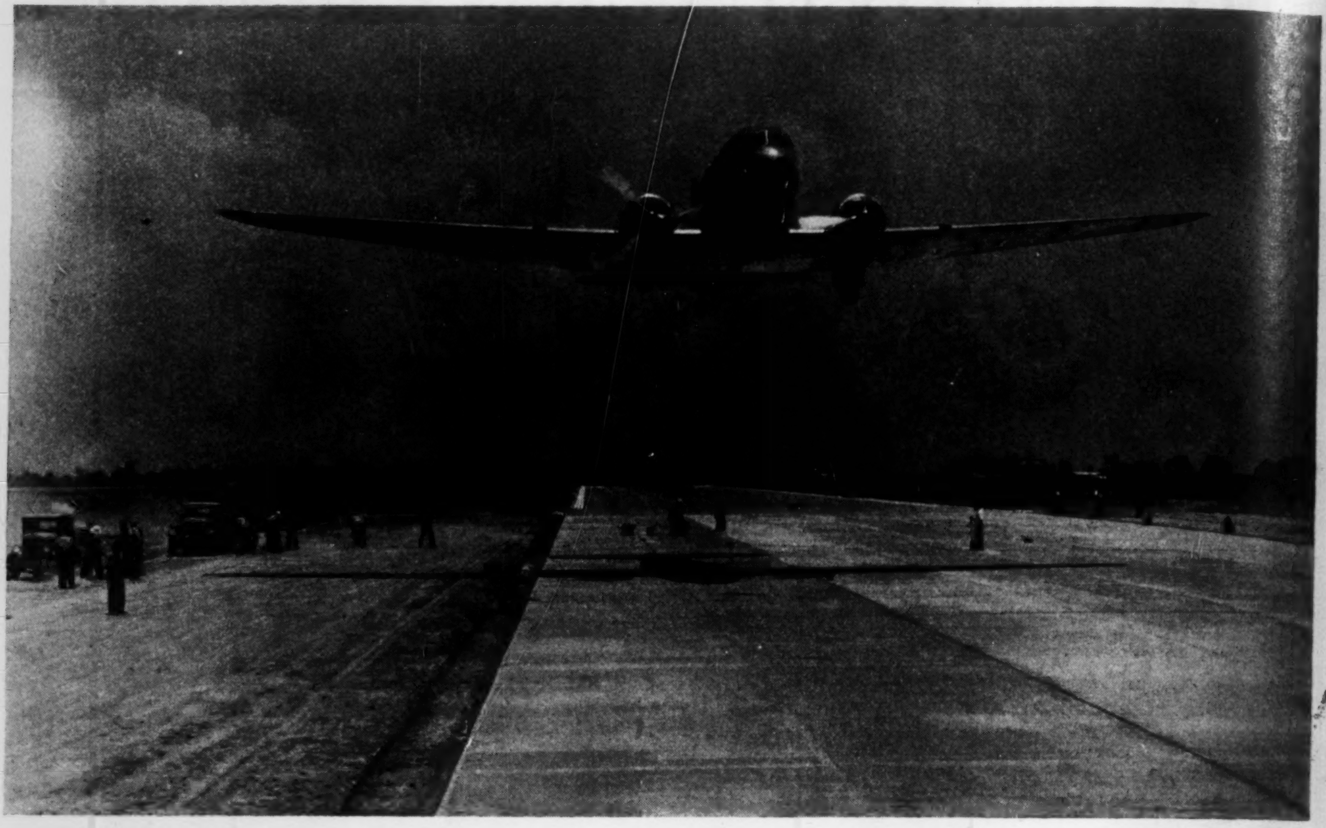

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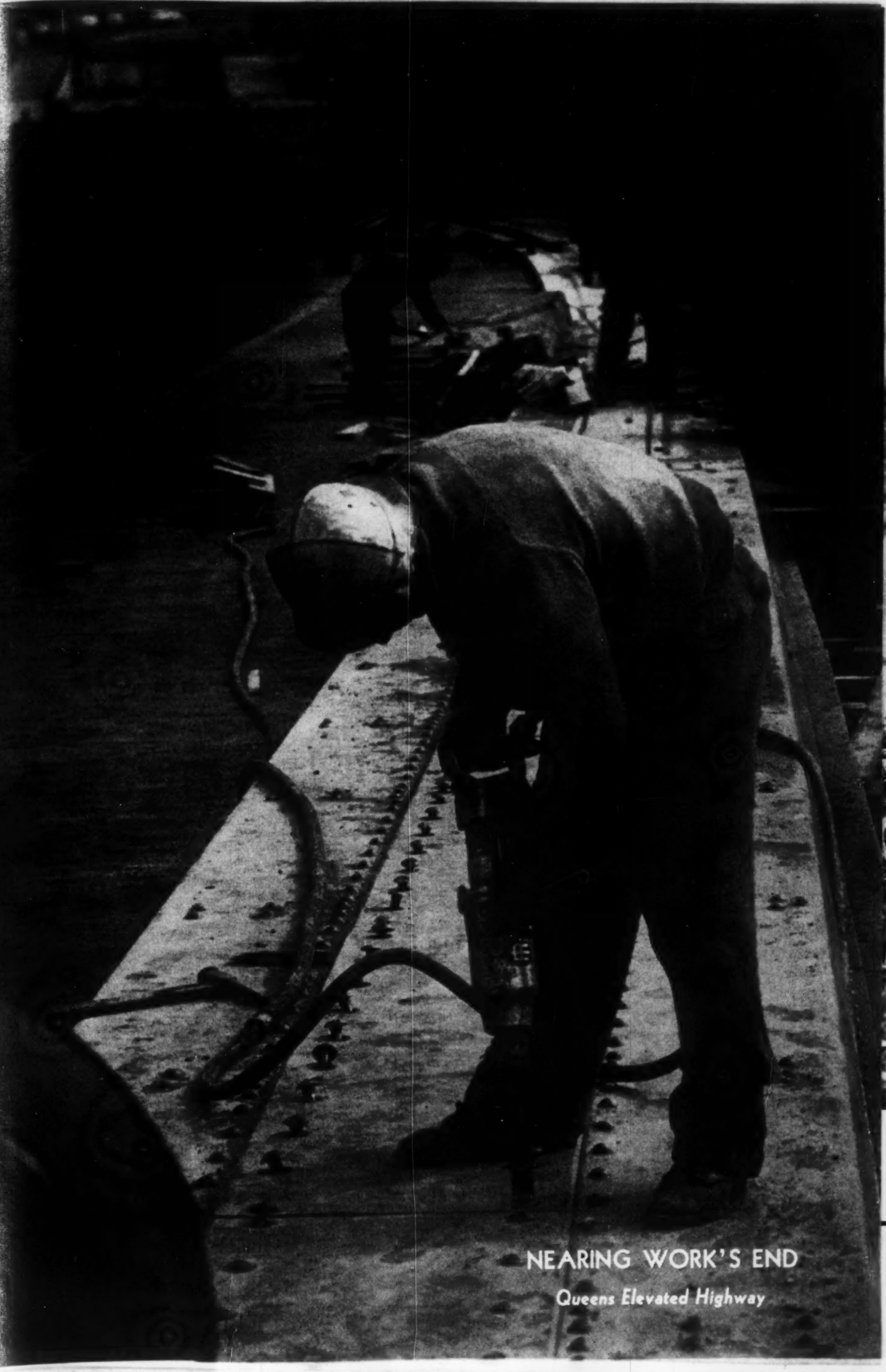

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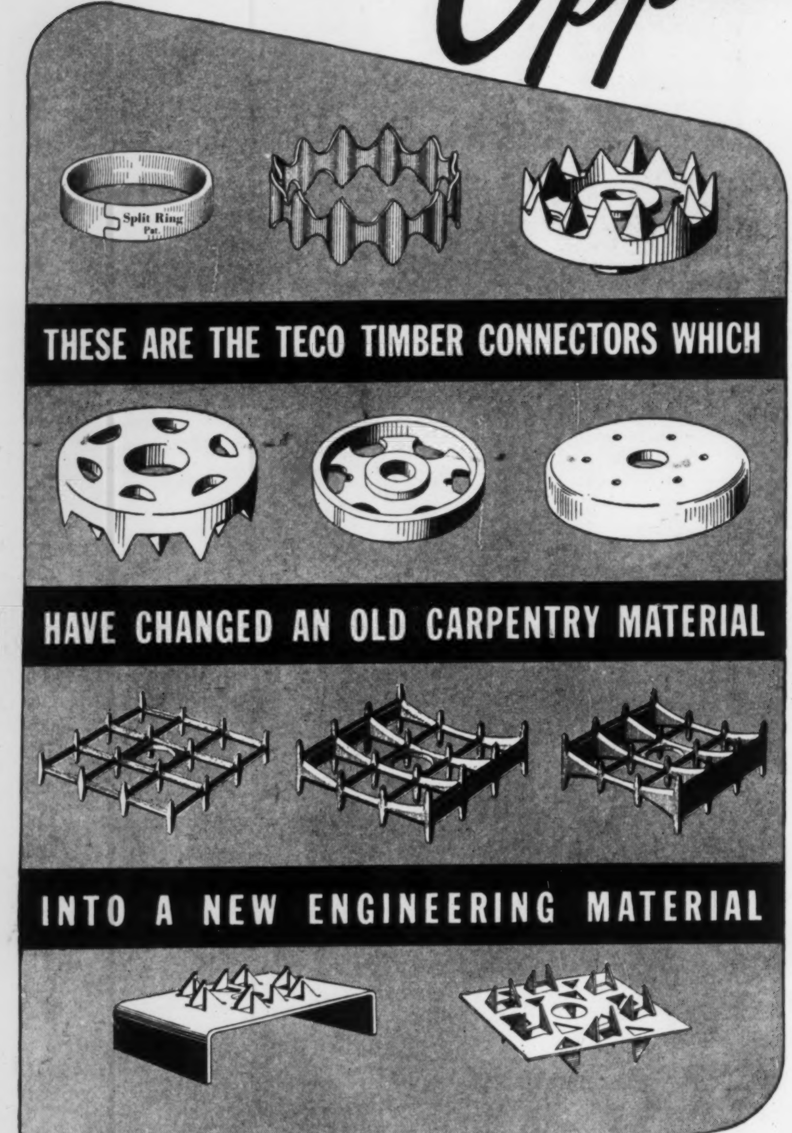
NEW DESIGN *Opportunities*



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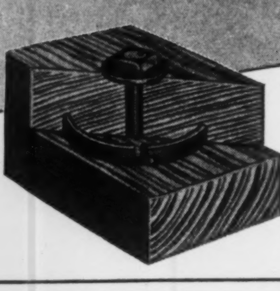

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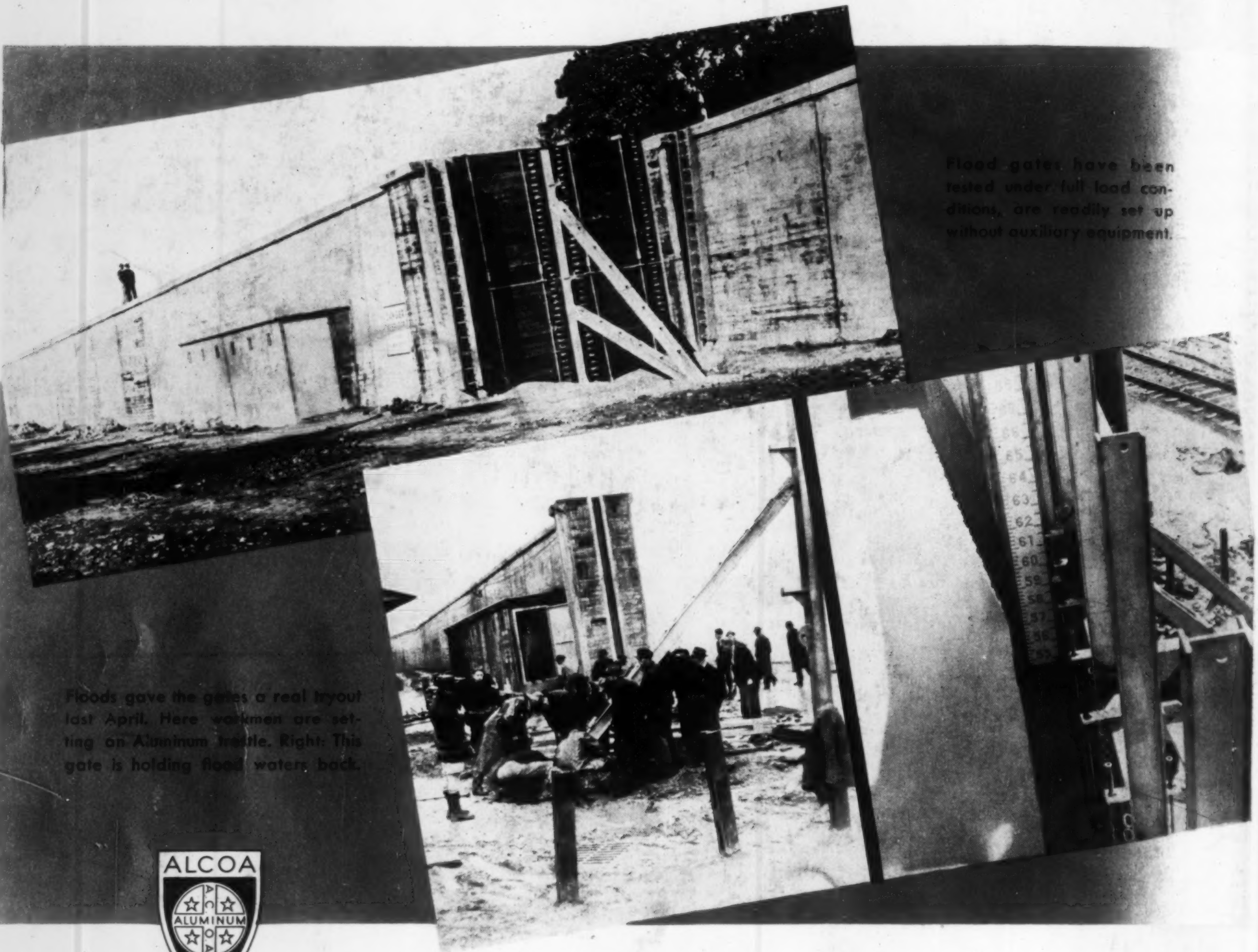
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

There are *no weak links* in these FLOOD PROTECTION WALLS



Flood gates have been tested under full load conditions, are readily set up without auxiliary equipment.

Floods gave the gates a real tryout last April. Here workmen are setting on Aluminum trestle. Right: This gate is holding flood waters back.

Systems of walls now protect Huntington, Kenova, and Ceredo, West Virginia, against floods. The gates, usually the most vulnerable points, can be quickly and securely sealed by timber stop-logs stored at each location.

Portable Aluminum Alloy trestles, designed by the U. S. Engineers Office, Huntington, W. Va., support these stop-logs. Vertical members, eight to twenty-one feet high, are special Alcoa extruded "H" sections, having a depth of 10 inches and unbalanced flanges 6 and 8 inches wide. They are designed thus to facilitate setting of stop-logs and to provide maximum strength with a minimum of metal.

Aluminum reduces the weight to a point where all parts can be man-handled, thereby obviating the use of any equipment for the erection process. It provides the necessary high strength, yet gives minimum bulk for storage. Because Aluminum does not rust, the equipment can be stored for years without loss of strength.

These structures demonstrate how the extrusion process can provide shapes to meet special requirements. Produced at moderate tool costs, they avoid the expense and delay incidental to reworking or assembling standard structural shapes. ALUMINUM COMPANY OF AMERICA, 2127 Gulf Building, Pittsburgh, Pennsylvania.

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